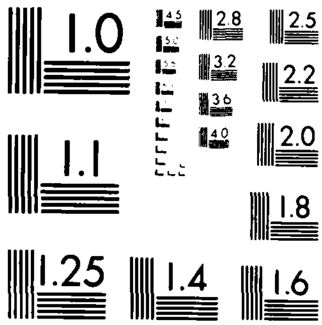
AD-A149 371 MAIN TEST DESIGN OF THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TEST AND EV..(U) ORI INC ROCKVILLE MD H CASEY ET AL. 20 JUN 77 ORI-TR-1132A MDA903-75-C-0016 1/2

UNCLASSIFIED F/G 15/5 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

AD-A149 371

DTIC ACCESSION NUMBER

PHOTOGRAPH THIS SHEET

LEVEL	INVENTORY
II	1

Rpt. No. ORI-TR-1132A, 20 Jun. '77
Contract MDA-903-75-C-0016

DOCUMENT IDENTIFICATION

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DISTRIBUTION STATEMENT

ACCESSION FOR		
NTIS	GRA&I	☒
DTIC	TAB	☐
UNANNOUNCED		☐
JUSTIFICATION		
BY		
DISTRIBUTION /		
AVAILABILITY CODES		
DIST	AVAIL AND/OR SPECIAL	
A/1		

DISTRIBUTION STAMP

DTIC COPY INSPECTED 1

DTIC
ELECTE
S JAN 14 1985 D
D

DATE ACCESSIONED

DATE RETURNED

85 01 08 140

DATE RECEIVED IN DTIC

REGISTERED OR CERTIFIED NO.

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-DDAC

DTIC FORM DEC 83 70A

DOCUMENT PROCESSING SHEET

PREVIOUS EDITION MAY BE USED UNTIL STOCK IS EXHAUSTED.

ORI

Operations Research, Inc.

OPERATIONS RESEARCH, Inc.

1400 Spring Street
SILVER SPRING, MARYLAND
20910

MAIN TEST DESIGN OF THE JOINT
LOGISTICS-OVER-THE-SHORE (LOTS)
TEST AND EVALUATION PROGRAM

20 June 1977

Prepared Under
Contract Number MDA-903-75-C-0016
For the Office of the Secretary of Defense,
Deputy Director (Test and Evaluation)
Office of the Director, Defense Research and Engineering
Washington, D.C. 20310

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: ORI Technical Report No. 1132A
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): MAIN TEST DESIGN OF THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TEST AND EVALUATION PROGRAM
5. TYPE OF REPORT & PERIOD COVERED: Final Report, Dec. 76 - June 77
6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): H. Casey, A. Green, G. Holiday, H. Knight, B. Perfect, W. Sutherland
8. CONTRACT OR GRANT NUMBER(s): MDA-903-75-C-0016
9. PERFORMING ORGANIZATION NAME AND ADDRESS: ~~Operations Research, Inc. 1400 Spring Street Silver Spring, Maryland 20910~~ ... DRIVE ... MARYLAND 20850-4311
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: Office of the Secretary of Defense/Deputy Director, (Test and Evaluation), ODDR&E, Rm 3D1080, The Pentagon, Washington, D.C. 20310
12. REPORT DATE: 20 June 1977
13. NUMBER OF PAGES: 97
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): N/A
15. SECURITY CLASS. (of this report): Unclassified
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE: N/A
16. DISTRIBUTION STATEMENT (of this Report): Approved for public release; distribution unlimited
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)
18. SUPPLEMENTARY NOTES: Contracting Officer's Technical Representative—Mr. Howard Kreiner
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

AFOE	COD	DeLong	Hatch bridging
Breakbulk	Crane	Deployment	Heavy-lift
Cargo	Crane-on-deck	Derating	Joint tests
Containerization	Crane platform	Elevated Causeway	LACH
Containership	Deck-loading	Flag vessels	LACV-30

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a report on the design of a joint Logistics-Over-The-Shore (LOTS) operational test to be conducted in the July-August, 1977, time frame. The report sets forth the purpose and objectives of the joint LOTS test, provides guidelines and parameters for its conduct, and outlines an analysis plan and data collection requirements. The report was prepared to provide detailed guidance to Service participants in the preparation of final test plans and has incorporated Service comments wherever appropriate. (continued)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

S/N 0102-014-6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

19. Key Words (continued)

Loading	Pretest	Terminal Service
Lighterage	SEABEE	Test and Evaluation
Logistics-Over-The-Shore	Shipping	Throughput
LOTS	Stowage	Transportation
Mobilization	TCDF	

20. Abstract (continued)

The report expands upon a LOTS Test Definition and Feasibility Study accomplished for the Deputy Director (Test and Evaluation), Office of the Director for Defense Research and Engineering, completed in FY 1975. That study outlined a test to evaluate the Services capability to conduct LOTS operations, including deployment, throughput, and the interface with distribution systems. At that time the need was recognized for the conduct of a series of preliminary field tests to demonstrate the feasibility of deploying selected LOTS heavy and outsized equipment aboard representative merchant ships and to provide data for refinement of the LOTS main test. The results of these tests, as applicable, have been incorporated in the test design. The report also includes a summary of the interim results of the LOTS simulation model used to validate the main test concept and refine resource requirements.

A multi-scenario setting describes the environment and operational parameters for each phase of the LOTS test. The test design concept calls for around-the-clock operations for about 3 weeks, during which time the majority of the cargo throughput will be containerized. The test cargo is provided by: a non-self-sustaining containership loaded with 600 weighted containers (discharged by a crane-on-deck and a temporary container discharge facility), a SEABEE ship with two barges, six separate LASH barges—both type barges loaded with test cargo—and a heavy-lift breakbulk ship with 600 short tons of palletized cargo and 300 drums of simulated POL products. The heavy-lift breakbulk ship and the SEABEE vessel will also embark selected LOTS heavy and outsized items as part of the deployment evaluation. In addition to the 600 containers, the containership will embark 8 x 8 x 20 shelters, a truck tractor and trailer. Containers will be backloaded periodically in order to support throughput requirements, first in a bare beach environment, second in an amphibious operation with an improved and secure beach, and finally, utilizing all available facilities in an improved beach operated by the joint Services.

ABSTRACT

This is a report on the design of a joint Logistics-Over-The-Shore (LOTS) operational test to be conducted in the July-August, 1977, time frame. The report sets forth the purpose and objectives of the joint LOTS test, provides guidelines and parameters for its conduct, and outlines an analysis plan and data collection requirements. The report was prepared to provide detailed guidance to Service participants in the preparation of final test plans and has incorporated Service comments wherever appropriate.

The report expands upon a LOTS Test Definition and Feasibility Study accomplished for the Deputy Director (Test and Evaluation), Office of the Director for Defense Research and Engineering, completed in FY 1975. That study outlined a test to evaluate the Services capability to conduct LOTS operations, including deployment, throughput, and the interface with distribution systems. At that time the need was recognized for the conduct of a series of preliminary field tests to demonstrate the feasibility of deploying selected LOTS heavy and outsized equipment aboard representative merchant ships and to provide data for refinement of the LOTS main test. The results of these tests, as applicable, have been incorporated in the test design. The report also includes a summary of the interim results of the LOTS simulation model used to validate the main test concept and refine resource requirements.

A multi-scenario setting describes the environment and operational parameters for each phase of the LOTS test. The test design concept calls for around-the-clock operations for about 3 weeks, during which time the majority of the cargo throughput will be containerized. The test cargo is provided by: a non-self-sustaining containership loaded with 600 weighted containers (discharged by a crane-on-deck and a temporary container discharge facility), a SEABEE ship with two barges, six separate LASH barges— both type barges loaded with test cargo— and a heavy-lift breakbulk ship with 600 short tons of palletized cargo and 300 drums of simulated POL products. The heavy-lift breakbulk

ship and the SEABEE vessel will also embark selected LOTS heavy and outsized items as part of the deployment evaluation. In addition to the 600 containers, the containership will embark 8 x 8 x 20 shelters, a truck tractor and trailer. Containers will be backloaded periodically in order to support throughput requirements, first in a bare beach environment, second in an amphibious operation with an improved and secure beach, and finally, utilizing all available facilities in an improved beach operated by the joint Services.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

GENERAL

In 1973 the Deputy Director (Test and Evaluation), Office of the Director, Defense Research and Engineering, requested the Services to submit nominations of projects suitable for joint test and evaluation in the FY 1975-77 time period. Among those nominated by the Army was a Logistics-Over-The-Shore (LOTS) operational test. The LOTS problem was of increasing concern due to trends in ocean shipping to containerships and the requisite military capability needed to adapt and deploy throughput systems to handle containers. LOTS was an area which had not been fully tested and involved new equipment and logistic operational techniques programmed for future procurement.

Early in 1975, the Deputy Director (Test and Evaluation) approved a feasibility and test definition study for a joint LOTS operational test prepared under contract with ORI.[1] The study outlined the general parameters of a joint LOTS test and recognized the need for a series of pretests to verify the feasibility of certain equipment deployment and employment options and to minimize the risk of major interruptions or delays in the main test. A follow-on report by ORI provided designs for such preliminary field tests to be conducted in calendar year 1976.[2]

The feasibility and test definition study provided the general concept and framework for the main test. This report provides the Joint Test Directorate (JTD) planning staff more definitive guidance for preparation of a detailed test plan.

---

[1] Operations Research, Inc., Feasibility and Definition of a Joint Logistics-Over-The-Shore (LOTS) Operational Test, ORI Technical Report No. 913, 30 April 1975.

[2] Operations Research, Inc., Design of Preliminary Field Tests for the Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 993, 6 January 1976.

This introductory section restates the purposes and objectives approved in the Feasibility Study, outlines the general scope of the main test, defines special terms for a common understanding of the environmental limitations and subsystems to be tested, and addresses those significant test events which were not pretested in 1976 and require special consideration in the ongoing planning of the JTD.

PURPOSE AND OBJECTIVES

The overall purpose of the joint LOTS test is to assess the capabilities of the Services to conduct LOTS operations. The basic test objectives are to provide information that can be used by the Services to:

- Alter or confirm:
  - Operational techniques
  - Planning factors
  - Equipment requirements
- Determine the best force structure for most efficient use of manpower.

The fundamental data and the derived information from the joint LOTS tests are intended to provide the following:

- An overall determination of the capabilities of a LOTS system representative of that which will be available to the Services in the 1977 to early-1980's time frame, specifically its responsiveness, productivity, and reliability.
- Accurate and reliable information on equipment performance when fully integrated into a system structure and stressed in a realistic operational environment.
- A realistic assessment of each LOTS unit's capabilities (generally measured in terms of quantitative throughput) and soundness of its organizational structure, command and control, doctrine and procedures.
- An operational evaluation of Service capabilities to deploy LOTS system elements including the impact of most likely available sealift assets on system cargo discharge concepts and capabilities.
- A determination of the effectiveness of a remote data terminal subsystem of the Standard Port System (SPS) for providing accurate and timely documentation for the identification, planning, control, and shipment of cargo transiting the beach complex.

- A basis for the development of LOTS force requirements to meet specified operational tasks in given contingency situations.

Specific test objectives have been submitted by each Service for evaluation in pretests already completed and/or the main test. A consolidated listing (duplications were eliminated through consolidation) has been compiled by the Joint Test Directorate (JTD) and is reproduced in Appendix A. Each of the Service test objectives has been reviewed by the Deputy Director (Test and Evaluation), ODDR&E for its particular appropriateness within the approved purpose, scope, and objectives of the joint LOTS main test. As annotated in Appendix A most of the Service test objectives can be fully accommodated in the main test design. As the DDR&E (T&E) major test objectives will have priority, concurrent R&D testing will be conducted so as not to interfere with or impede scheduled throughput operations.

SCOPE

The joint LOTS main test will be conducted in a multi-scenario setting, reflecting likely non-mobilization and full mobilization situations as defined below and in Appendix B.

Three vessel types are planned for charter: a containership loaded with a crane-on-deck (COD) and containerized cargo; a heavy-lift breakbulk ship loaded with selected LOTS equipment and breakbulk cargo; and a SEABEE bargeship loaded with barges containing vehicular, palletized, and containerized cargo, plus deck-stowed selected outsized LOTS equipment.

The main test will be conducted during the July-August 1977 time frame. With allowances for delays due to weather and/or underlapping ship schedules, the exercise is planned to be completed in about 28 days. For the overall schedule of test events see Figure 1.

LOTS TEST ENVIRONMENT, SUBSYSTEM DEFINITIONS

For a realistic test and evaluation of Service capabilities to conduct LOTS operations, a three-phased approach with appropriate scenarios was adopted. The first phase represents the worst case: the bare beach capabilities representative of a non-mobilization contingency in an underveloped area. This situation depicts LOTS operations conducted over a beach facing an open sea which, prior to force arrival, lacks piers, jetties, or like structures that could be used to assist the force in the transfer of personnel, equipment, and other cargo from ship to shore (hence the term "bare beach"). Site improvements will be limited to the capabilities of the LOTS personnel, tools, and equipment which can be deployed within the time and shipping/aircraft available as specified in this test design. Improvements will be necessary to facilitate movement to and over-the-shore, the emplacement of cargo handling equipment, movement of beach traffic, and establishment of operating units and their command/control elements ashore.

The two phases that follow will involve improvements through the erection of off-shore and shoreside container/general cargo transfer facilities

DAY

TEST	T-8	T-7	T-6	T-Day	T+1	T+2	T+3	T+4	T+5	T+7	T+8	T+9	T+10	T+11	T+12	T+13
SCENARIO	N/A	N/A	N/A	D-3	D-Day	D+2	D+4	D+5	D+15	N/A	N/A	D+24	D+25	D+26	D+27	D+28
ACTUAL *	13 Jul	14 Jul	15 Jul	21 Jul	22 Jul	23 Jul	24 Jul	25 Jul	27 Jul	28 Jul	29 Jul	30 Jul	31 Jul	1 Aug	2 Aug	3 Aug

INSTALL ELEVATED CAUSEWAY (T-8 to T-6)

T-Day: Warning Order Issued — Load 600 Pallets on BC Barges at Ft. Eustis

T+1: Execute Op Plan — Stage HL B/B Equip at NSC

T+2: MovOrd Issued

T+3: Commence Beach Marshalling Prep — Adv Pty Deploys

T+2 to T+4: Tow Barges to NSC

T+4: LOAD SEABEE BARGES AT NSC

T+5: Main Body Deploys

HEAVY-LIFT BREAKBULK

T+5	T+7	T+8	T+9	T+10	T+11	T+12	T+13
Present Date Start Load	Comp. Load Sails	Arrive Ft. Story Off-Load Equip	Con't Off-Load Equip	Comp. Off-Load Equip	At Anchor	At Anchor	OFLD 150 Pallets, 75 Drums

T+11: Complete Beach Marshalling Prep

T+11	T+12	T+13
Present Date, Start Load	Comp. Load Sails	Arr. Ft Story OFLD Vehs USMC Shelter 25-40' cntr 125-20' cntr (450 O/B)

SEABEE SHIP

T+9	T+10	T+11	T+12	T+13
Present Date Load 2 Barges and Equip	Comp. Load and Sails	Arr. Ft. Story OFLD Equip	OFLD Barges and Sails	We... [illegible] #1

T+8: Load 6 LASH Barges at Little Creek

NOTE Schedule is not fixed. The Test Director may adjust for delays due to weather and other contingencies to insure attainment of major test objectives in each phase to the extent possible within the available time.

*Best estimate available

KEY

Adv Pty	–	Advance Party
Cntr	–	Container
COD	–	Crane-on-Deck
E.C.	–	Elevated Causeway
HL B/B	–	Heavy-lift Breakbulk
JUD	–	Jacked-up DeLong
LACH	–	Lightweight Amphibious Container Handler
LASH	–	Lighter-Aboard-Ship
MovOrd	–	Movement Orders
O/B	–	On-board
Ofld	–	Off-load
Retro	–	Retrograde

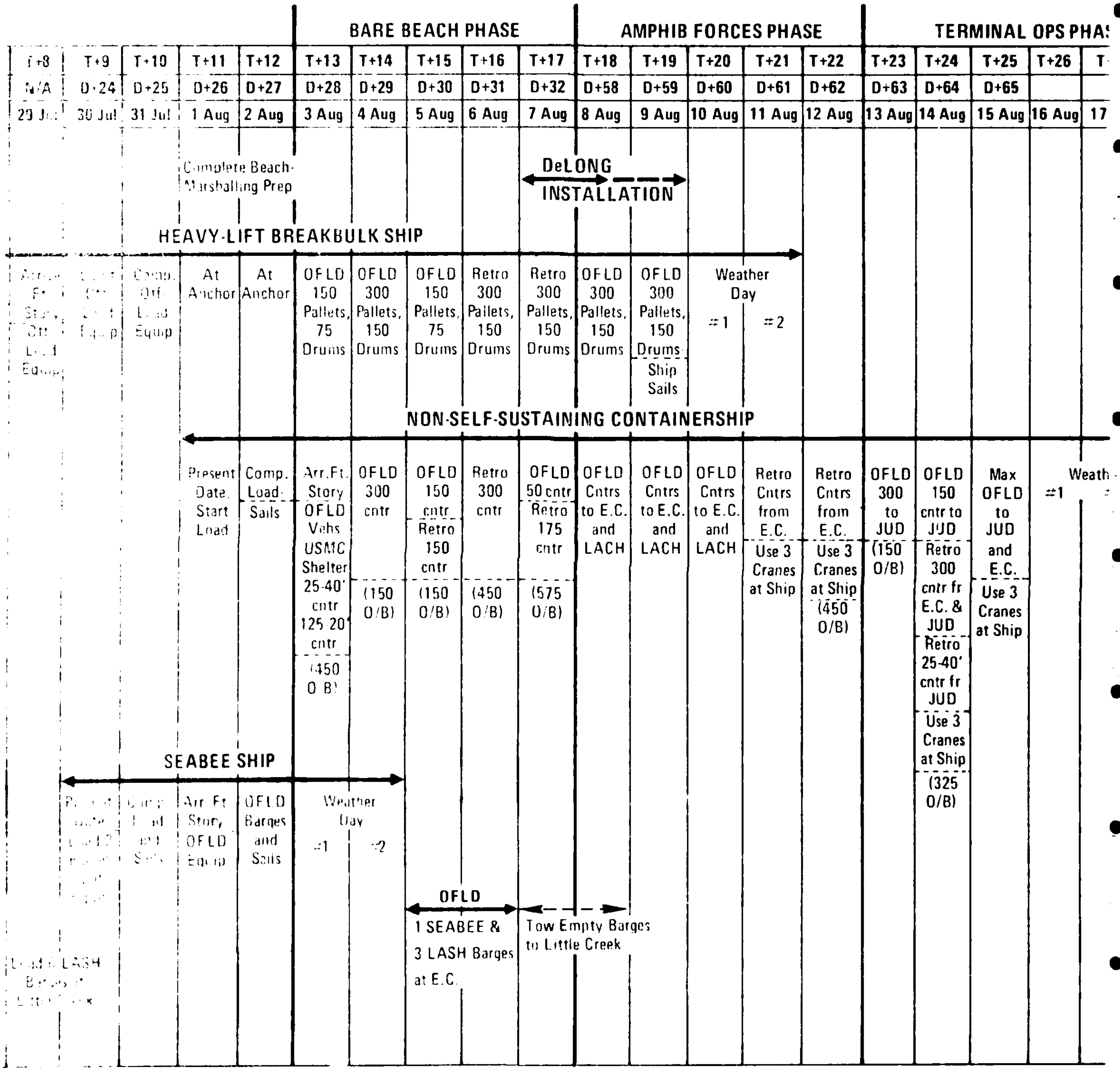


FIGURE 1. ILLUSTRAT
(Real Test Time and

2

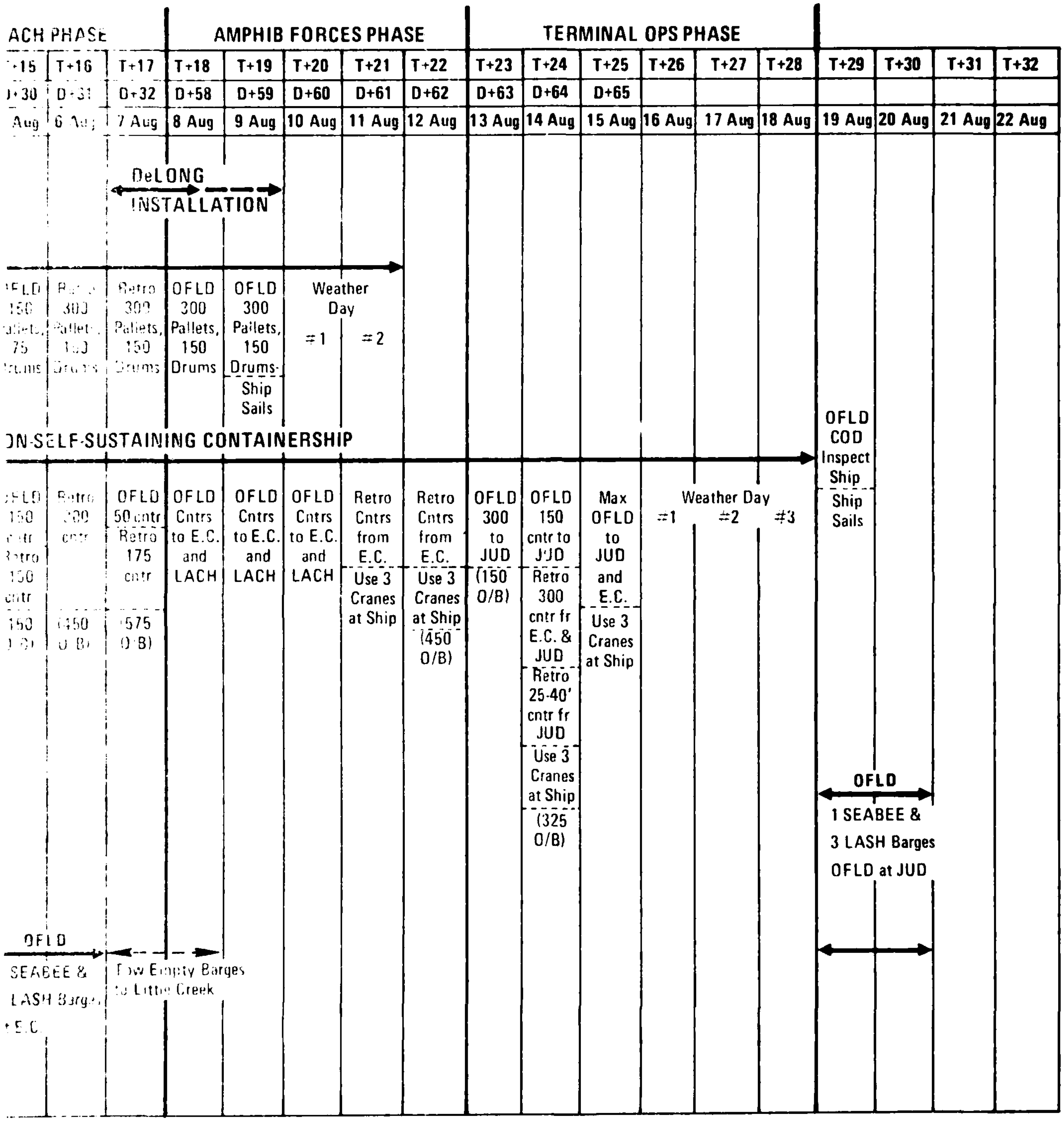


FIGURE 1. ILLUSTRATIVE MAIN TEST EVENT SCHEDULE
(Real Test Time and Multi-Scenario Time Phasing)

2

which would be available in a mobilization setting. In this test the improved beach phase will include the use of the elevated causeway and the "B" DeLong pier with cranes for transfering cargo. The temporary container discharge facility (TCDF) would also be available during this phase.[3] The facilities and equipment to be used in both the bare and improved beach settings are described in detail in Section II under "Description of System Elements to be Tested." General definitions are given here for an understanding of the discussions that follow. Where applicable, Service proponency for development is as indicated in parentheses.

- Crane-on-Beach. A container handling crane installed on a platform on the beach. The most rudimentary type consists of a sand ramp, or small jetty of sand or other immediately available materials surfaced with planking over prefabricated timber "mud shoes." The crane transfers containers from lighters (non-amphibians) to vehicles for movement to a cargo marshalling area. An analysis of shoreside unloading difficulties with respect to beach gradient and surf is contained in Appendix C. (Army proponency.)

- Crane-on-Deck (COD). A crane working from a set of movable prefabricated platforms placed on the deck of a containership. The concept for actual emergency operations is to employ two sets of equipment, each crane moving from opposite ends of the ship alternately opening and closing hatches and discharging containers to lighters alongside. For the LOTS test *only one* COD is planned. (Navy proponency.)

- Temporary Container Discharge Facility (TCDF). A container handling crane mounted on a floating platform for the transfer of containers from ship to lighters. The test equipment consists of an Army P&H 6250 (300-ton capacity) crane mounted on a DeLong floating pier section. (Army proponency.)

- Elevated Causeway. Floating causeway sections, with specially installed spud wells, joined together and elevated above the surf on pilings/spuds. A mobile crane is placed on the end section for transfering containers from lighters to vehicles. (Navy proponency.)

- Test (T) Days and Scenario (D) Days[4]

  - In the schedule of test events contained in Section II, Main Test Design, and summarized in Figure 1,

---

[3] Note that in the bare beach phase the TCDF is operating as a second "crane-on-deck" in order to have two cranes discharging and backloading containers.

[4] The designation of test days by another reference point such as "X" days as the first day of containership operations off Ft. Story may be used by the JTD planning group for keying test events to the availability of the containership.

T-days are the days in the test design in which specific test events or milestones are scheduled. Beginning with the date a warning order is issued for deployment, T-days extend through all test phases and scenarios and indicate when a major data collection effort is required.[5]

- D-day is defined as the day the order is given to execute the operations plan. D-days are keyed to the scenario and depict realistic times for deployment of units and their equipment to the objective area. It is not defined as the date amphibious forces assault a beach head.

RESIDUAL PRETEST EVENTS

Pretests were conducted during 1976 and addressed the feasibility of various equipment deployment options by different types of vessels. The operating capability of the subsystem elements described and defined above were also addressed to a limited degree. The following test actions were planned but have not been carried out to date:

- Deployment of major LOTS equipment items by containership with COD. The test was cancelled after engineering studies revealed the magnitude of a special R&D effort to achieve it. Capabilities of the COD platform with crane have not been tested.

- Deployment and operation of the LACV-30 (Lighter, Air Cushion Vehicle, 30-ton capacity) in an operational environment. This craft currently is undergoing extensive user acceptance testing. Data derived from these tests will be used for main test planning (average speeds, loading and unloading times, fuel-payload trade-offs, etc.). Deployment test lifting will be accomplished prior to the joint LOTS test.

- Test loading of a "B" section DeLong pier on a SEABEE bargeship. Test cancelled due to non-availability of ship for such a lift until litigation over elevator defects is concluded. Data has been compiled for analysis and a report completed on the feasibility of this deployment option.[6]

---

[5] The erection of the elevated causeway, discussed later, is a special case in which data collection will be subject to further refinement once elevated causeway scheduling and training objectives can be more clearly defined. Therefore, no T-day has been established for this event.

[6] Operations Research, Inc., Report on the Cancelled SEABEE Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1148, 15 June 1977.

- Deployment and employment of the Army frontloader for handling 20 to 40-ft containers. Delivery was not completed until after March, 1977. Equipment should be deployment-tested in the LOTS main test.

- Due to lack of Army capability (serviceable assets on hand), the handling of bulk fuel from tanker-to-shore and distribution inland will not be played. No assets are programmed for FY 1977 procurement.[7]

The results of pretests, principal equipment deployment feasibility and timing data, have been incorporated in the main test design outlined in this report and will be considered in the preparation of the operational plans of the JTD.

---

[7] Information provided by U.S. Army Quartermaster School project officer, as of December, 1976.

II. MAIN TEST DESIGN

GENERAL

This section provides guidelines for the development of detailed test plans and operation orders by the JTD and participating units. The major topics are arranged in the following sequence:

- Measures of effectiveness (MOE)
- Planning factors
- Deployment
- System elements to be tested.

Measures of effectiveness and planning factors are treated first because of their importance in the sequencing and duration of test events. Similarly, the requirement to validate planning factors requires round-the-clock operations under existing environmental conditions over a prolonged period of time. Deployment describes the parameters within which the units move from home station to the objective area and the constraints on procedures, resources, and facilities before becoming operational. This is followed by a detailed description of the LOTS system elements and the conditions under which they will be tested. A brief summary of preliminary LOTS simulation model runs is given in Appendix D as a basis for test planning. Additional simulations will be made as detailed planning progresses and the impacts of proposed changes need to be assessed.

MEASURES OF EFFECTIVENESS (MOE)

The overall effectiveness of a LOTS system is judged on its ability to provide timely and adequate support to combat forces. In order to provide a basis for measurement and analysis, LOTS system capability is normally expressed in terms of daily "throughput." This throughput, generally stated in

tons (and/or numbers of containers) per day for dry cargo, is the amount of resupply unloaded from shipping and cleared daily from the beach complex by highway, rail, inland waterways, etc. In view of the sensitivity of LOTS operations to weather conditions, the system must be adaptable to and operate under a fairly wide range of conditions and over time still meet average throughput requirements. Sufficient quantities of supplies must be transhipped to inland supply points not only to sustain daily consumption but also to build up a safety level for accommodating interruptions and losses due to enemy action, storms, and the like. That average daily total requirement becomes the operating objective of the LOTS force.

Note that unlike weapons system effectiveness, where the numbers involved sometimes have self-evident evaluations (such as single shot kill probabilities) there is no norm or standard for throughput support. Comparisons can be made with planning factors where these have been established, but generally the effectiveness of the LOTS operation will have to be judged, not on a comparison basis, but rather on internal evidence, such as the capabilities of making the most effective use of available manpower and equipment.

Deployment MOEs

The ability to deploy a LOTS system, particularly very large and heavy equipment, will be the first major area to be evaluated. Deployment as used herein encompasses all steps necessary to move equipment, personnel, and supplies to an objective area and establish a throughput capability. Thus, deployment measures of effectiveness must take into account the capability to use the most available sealift resources (MSC assets, in this case), the capability to lighter this equipment ashore, the establishment of an unloading system, and the resultant impact on system cargo discharge concepts and capabilities. Deployment will include both simulated air and sea movement, as well as that cargo actually moved by ship. The deployment phase terminates when a throughput capability is established ashore and LOTS operations begin.

Sequentially, the first MOE relates to the ability of the exercise unit to meet deployment schedules (discussed later). Once these schedules are met the exercise of loading selected items will provide the opportunity to ensure that the means and capabilities for loading the extraordinary LOTS equipment items are operable and effective, and ship departure schedules can be met. Once the equipment has been moved to the objective area, the ability and time to lighter this equipment ashore, off-load it from landing craft, and become operationally effective will be important. Time will be one of the most important measures upon which judgment on deployment effectiveness will be based.

Not all MOEs on deployment will be based on data collected in the Test.[1] Table 1 contains examples of deployment MOEs.

---

[1] Operations Research, Inc., Feasibility and Definition of a Joint Logistics-Over-The-Shore (LOTS) Operational Test, ORI Technical Report No. 913, page C-3, Appendix C, 30 April 1975.

TABLE 1

DEPLOYMENT MEASURES OF EFFECTIVENESS

Test Objective	Measures of Effectiveness
Confirm the capability of terminal service units to meet CONUS load-out times.	Time required to meet deployment requirements for overseas movement and move to appropriate POE's.
Confirm the capability to load selected items of LOTS equipment aboard commercial shipping.	The time required to load each item.
Establish a throughput capability for movement of containers across a bare beach.	Total time required for terminal service units to establish its throughput capability (containers per day).

Throughput MOEs

Throughput is the net output of the entire LOTS operation system. The most restrictive subsystem capability determines the throughput capability of the entire system. With the resources available the LOTS commander allocates personnel and equipment to balance cargo handling and transport capabilities. Adjustments are made as conditions (types of cargo, environmental conditions, etc.) change in order to maximize throughput.

Planning factors are closely akin to these measures of effectiveness. Already established LOTS system planning factors will be altered or confirmed and new planning factors will be derived from test data accumulated through the execution of the test. (The planning factors to be evaluated in the Main Test are listed in Table 4 and discussed later.) Table 2 contains examples of throughput MOEs related to specific test objectives.

TABLE 2

THROUGHPUT MEASURES OF EFFECTIVENESS

Test Objective	Measures of Effectiveness
Confirm the capability of the USA Trans. Terminal Co. (container) to handle containers (import and combination of import/export).	Number of containers sustained throughout per 20-hr day: 1) all import 2) combination import/export.
Determine the container handling capability of specified LOTS subsystems (COD, TCDF, etc.) or equipment items (LACH,* rough terrain forklift, etc.)	Number of containers off-loaded/handled per 20-hr day by each subsystem or equipment item.

* Lightweight Amphibious Container Handler (LACH), a Marine Corps experimental vehicle for handling containers on the beach, in the logistic support area, or other unimproved areas.

Distribution System

General. Since the exercise area is confined to the limits of Ft. Story, the designated locations of consignees (DSUs, GSUs, etc.) will be relatively close to the marshalling area. Direct delivery of supplies to consignees will be played; therefore the distribution segment being evaluated will include movement from the beach to and through the marshalling area to the consignee. There will also be a requirement for limited unstuffing of containers for shipments from the marshalling area. The most important area to be evaluated will be military standards and procedures, MILSTAMP, for identifying, locating, documenting, accounting, controlling, and forwarding cargo to consignees. Organizational structure, equipment, and manpower utilization as they affect this portion of the distribution system will also be evaluated.

Cargo Distribution Managment. Manifests and related data will be transmitted from Eastern Area Military Traffic Management Command, (EAMTMC) Headquarters via AUTODIN communication links to the fixed logistics base at Ft. Eustis, Virginia. The data will then be processed by a UNIVAC 70/15 computer in the Army's Standard Port System (SPS) format. If a transceiver type terminal is colocated with the SPS mobile van at the beach, the data will be transmitted direct from the logistics base. Otherwise, the data will be transmitted to an AUTODIN terminal at Ft. Story and hand delivered to the mobile SPS van. This van contains card reading and punching equipment, a remote printer which can produce and copy documents used in checking, identifying, controlling, and positioning cargo on the beach and in the marshalling area. Evaluation will center on system response time and probability of performing essential functions in a LOTS environment. An element of headquarters, 1st Corps Support Command will provide player support for movement control functions in the exercise. Although this command element will not be evaluated, the response of the LOTS organization to the movement control play (changes in priorities, consignees, etc.) will be.

Distribution System MOEs. The kinds of measures of effectiveness that are expected to be useful in the distribution portion of the LOTS test are deployment times, cargo management and distribution capabilities. Table 3 contains examples of specific MOEs.

TABLE 3

LOTS DISTRIBUTION SYSTEM MEASURES OF EFFECTIVENESS

Test Objective	Measures of Effectiveness
Verify the technical capabilities and adequacy of field operating procedures to provide all required transportation data and documentation.	Initiating and maintaining records identifying containers and breakbulk cargo and sorting them for appropriate destinations in a timely manner.
	Docmentation capabilit; for all cargo and container movements per day. (All delays in movement of cargo due to faulty or non-available documentation will be recorded.)
	Percent of errors in documentation: cargo identification including special codes, consignee, mode, date-time of receipt and shipment, etc.
Emergency continuity of operational procedures.*	All procedures used to continue SPS operations from temporary disruption to total loss of mobile van.
Deployment and environmental effects on SPS equipment.	Determine any adverse effects of weather (dust, etc.) on operating efficiency of the ADP equipment and communication links.

* At a specified time during the exercise the mobile SPS van will be shut down simulating the loss of the equipment due to mechanical failure.

PLANNING FACTORS

Service unit capabilities for conducting LOTS operations and existing planning factors both need to be validated as most of them were derived from limited exercise experience and estimates. In the analysis of data, any inefficiencies, delays, and interruptions normal to actual operations will be taken into account. All decisions concerning non-chargeable time delays will be made on a case by case basis.

Examples of key LOTS planning factors which require quantitative validation in a realistic operational environment are contained in Table 4.

TABLE 4

KEY LOTS PLANNING FACTORS

Unit/Item Being Tested	Quantitative Factor or Capability to be Validated
Trans Tml Bn Hq	Command and control of tml units
Trans Tml Co. (Container)	300 containers/day discharge or retrograde combined
Trans Tml Co. (Breakbulk)	1,000 S/Tons general cargo/day
Trans Med Boat Co.	1,000 S/Tons per day (number of containers/day to be determined)
Trans Hvy Boat Co.	1,440 S/Tons per day (number of container/day to be determined)
Trans Med Amphib Co.	Number of containers per day (to be determined)
Trans Hvy Amphib Det.	Number of containers per day (to be determined)
Trans LACV Plat (Prov)	240 containers/day (tentative)
USMC Marine Support Element (MSE)	Capabilities to be determined.
Elevated Causeway	Time to erect and capabilities to be determined.

DEPLOYMENT

General

Deployment of LOTS equipment and personnel constitutes one of the major areas of analysis of the LOTS system. Thus, the means for deployment and the requirements to execute movement of LOTS units must be closely detailed. Generally, it is planned that Army units will be deployed via airlift[2]

[2] Movement by air will be simulated.

for personnel and high priority engineering equipment such as dozers and the advanced multipurpose soil stabilization (AMSS) equipment needed to initiate site preparations. Commercial shipping will be used for all other unit equipment. Navy and Marine Corps exercise units will primarily be deployed in assault force shipping (amphibious ships)[3] with some equipment and personnel embarked in commercial ships of the assault-follow-on-echelon (AFOE). Details for unit deployments are discussed later.

It will not be necessary to embark all equipment aboard merchant ships, but rather deployment objectives can be satisfied by selectively loading equipment aboard certain ship types for introduction into LOTS scenarios as appropriate. This approach is necessary to limit test duration and facilitate ship employment during the test. The majority of the equipment deployed will be test loaded aboard the heavy-lift breakbulk ship prior to the initiation of bare beach operations.

Heavy-Lift Breakbulk Ship Deployment

Representative items of LOTS equipment will be embarked aboard a Military Sealift Command (MSC) chartered vessel, specifically, a heavy-lift breakbulk ship from the controlled fleet. Subject to vessel schedule and space available, a minimum of one of each type of equipment weighing more than 20 tons will be embarked to ensure that slings, shackles, and other necessary rigging gear are available and usable. The equipment to be loaded, for example, will include (but not be limited to) the following Service equipment: sideloader, frontend loader, P&H 9125 crane (tactical configuration), P&H 6250 crane (tactical configuration), LARC-LX, mobile Standard Port System (SPS) automated data input/output van, LACV-30, LCM8, 1646-class LCU, 1466-class LCU, yard tractor and trailer. Other support equipment may be embarked as directed by the JTD or as requested by the Services, subject to ship space availability. In the event a heavy-lift breakbulk ship is not available, two conventional breakbulk ships with heavy-lift booms of 60-long ton or greater capacities may be substituted.

SEABEE Ship Deployment

In the likely event a SEABEE ship becomes available prior to the containership, the LACV-30 will be test loaded as a deployment item. This includes the necessary modifications to a container adaptor frame on which the LACV-30 must be loaded. Other adaptor frames will also be modified to physically load some of the equipment. Independent of ship availability, an LCM8, a 1466-class LCU, a 1610-class LCU, either a 3 x 15 causeway section or a 3 x 14 section warping tug, a LARC-LX, and two SEABEE barges will be loaded. Other Service equipment may be deployed during the 4-day charter period, subject to the approval of the JTD.

Although the SEABEE ship is scheduled to participate in the mobilization phase, ship availability and the critical timing of certain test events

---

[3] Assault shipping will be simulated, although an amphibious ship is tentatively planned for movement of USMC units from Camp Lejeune, North Carolina, to the objective area.

necessitate that its scheduling be more flexible. The SEABEE vessel chartered must be used as it becomes available, otherwise, additional and unnecessary charter costs are incurred by delaying its employment. With such a vessel the needed flexibility is possible. The deployment cargo (i.e., deck-stowed items) will be off-loaded and lightered ashore upon arrival off Red-Blue Beach, Ft. Story.

The two SEABEE barges will be moored with six LASH barges, administratively introduced. One SEABEE barge and three LASH barges will be off-loaded at the elevated causeway during but not associated with the bare beach phase. The remaining barges will be kept moored in a "stand-by" status until additional cargo is needed ashore at the DeLong pier. If no additional cargo is needed during the improved beach phase, then the barges will be off-loaded after container operations ashore have ended.

NSS Containership Deployment

An examination of capabilities to use the NSS containership as an augmentation vessel for deployment proved during the pretest phase that out-sized equipment heavier than containers could not be accommodated. However, the capabilities to use the ship for some light equipment items (other than those previously discussed) are possible. Accordingly, the test load on the NSS containership should include a truck-tractor and container chassis. In addition, USMC 8 x 8 x 20 shelters will be loaded in container spaces.

Documentation Support

To support deployment analysis the LOTS exercise Joint Task Force (JTF) commander must realistically ensure preparation of all documentation (less ship and aircraft stowage diagrams) necessary for movement of task force personnel, equipment, and unit impedimenta. Complete documentation is considered important enough to merit prohibiting entrance to Ft. Story of all military tactical equipment and organizational property employed in the test unless accompanied by shipping documentation/embarkation data. (Special procedures will be developed for vehicles that arrive inadvertently without proper documentation.)

Once aboard the Ft. Story complex, unit equipment should not be permitted to depart until termination of the exercise or unless the item is being "retrograded to CONUS by sealift/airlift." Order and shipping times for the replacement of "retrograded" equipment would exceed the length of the test exercise. Therefore, if an item is "retrograded," neither it nor its replacement can be expected to return to service during the remainder of the exercise. These restrictions appear necessary to ensure that deployment requirements are fully identified, including supply and maintenance support for participating units.

Deployment for Army Bare Beach Operations

To support the bare beach phase of the test (non-mobilization scenario) an advance party will be airlifted to the objective area for site reconnaisance. A limited number of aircraft sorties will be available to also

transport high priority units and equipment for initiation of site preparation. This simulated airlift will begin 23 scenario days prior to the commencement of the cargo throughput phase of the exercise. The Army component commander is required to submit unit movement requirements to the Military Traffic Management Command through installation transportation officers. (ORI acting for ODDR&E (T&E) will receive documentation and simulate action of all agencies outside the JTD; in addition, the JTD will act as the area Commander-in-Chief (CINCAREA).) For exercise purposes this requirement should be forwarded not later than 15 June 1977 for sortie approval/allocations.

Follow-on deployment of personnel will be accomplished via airlift commencing D+15, to be completed 72 hr prior to arrival of the first commercial ship. All unit equipment normally deployed in the seatail will be embarked in this echelon. For the non-mobilization scenario only one ship, a heavy-lift breakbulk ship, will be available for actual seatail deployment. Personnel and cargo not embarked aboard the test ship will be moved via land to Ft. Story where shipping documentation can be checked by exercise control personnel at the Ft. Story gates. If some of this cargo is moved by landing craft or amphibians to Ft. Story, the same documentation and data collection checks must be made at the off-loading point.

Deployment of Amphibious Forces

Participating amphibious units would normally have the majority of their personnel and cargo handling equipment embarked in the assault shipping. Exceptions might be (subject to the amphibious mission) the Navy Cargo Handling and Port (NAVCHAP) Group, certain organizations having heavy equipment and vehicle support and some heavy engineer units. Amphibious assault shipping has the capability to deploy the elevated causeway system, assuming tactical requirements permit— for this scenario it is assumed the elevated causeway was deployed in this manner. The elevated causeway will be erected prior to the arrival of the containership. Navy and Marine Corps personnel and their equipment will be administratively introduced into the LOTS exercise in much the same manner that Army units were "airlifted" to the objective area. Embarkation data will be submitted on all personnel and equipment participating in the exercise.

Improved Beach Operations

This aspect of the LOTS test allows for the introduction of very large LOTS components that have special shipping requirements which are not likely to be met unless there is a national mobilization. No deployment restrictions are placed on the size or type of LOTS support equipment which may be introduced at this time, as long as it can be loaded on some U.S. merchant ship. Because of current litigation between the ship owner and ship builder it probably will not be possible to load the SEABEE with DeLong barges in the test. However, for exercise purposes, deployment by SEABEE is assumed.

The joint LOTS main test plan commences with the alert of participating units and the assembly of a Joint Task Force command element at Ft. Eustis, Virginia. Units are brought to a high state of readiness and prepared to deploy to aerial and sea Ports-of-Embarkation (POEs) on order.

Seventy-two hours after receipt of the warning order (on D-3), orders are received to execute the operation plan (D-Day). Advance parties of the JTF headquarters and elements of the port construction and other key units depart for the objective area on D+4 and D+5. (Movement by air will be simulated. Advance parties will move by highway to Ft. Story and begin establishment of an operating base.)

Ten days later (D+15) the main party begins its deployment by air with minimum essential equipment to assist in preparation of the beach site, routes to and from an assembly area, etc. The deployment will be accomplished in seven echelons to be completed by D+21. Although all such equipment actually will be moved by surface means, each item will be documented indicating full nomenclature, and dimensions and how deployed; e.g., tractor, FTRAC, D7 with dozer blades, 168 in. x 83 in. x 61 in., 36,805 lb, 492.2 cu, deployed by C141 or C5.

Five days after receipt of movement orders (D+7) the simulated JTF seatail echelons depart for loading at water ports of embarkation. The seatail for this test will include LOTS outsized and heavy equipment (discussed above) loaded on the heavy-lift breakbulk ship. The balance of the unit table of organization and equipment (TOE) and accompanying supplies will move by surface means to the operating area. Again, all major equipment items will be documented. Data will be obtained for later compilation of shipping that would have been required to deploy these units.

The advance parties and main bodies—both air and seatail—will deploy early enough during the exercise to ensure that the beach is fully operational before the non-self-sustaining containership is standing off-shore. Backward planning from that date is required to meet beach preparation objectives.

Because amphibious units are part of a separate scenario (the above scheduling relates only to bare beach operations) and because Navy units will be conducting unit training at the test site, these deployment schedules will not apply. Marine Corps advance units will be administratively positioned ashore prior to arrival of test vessels on which USMC equipment is embarked.

DESCRIPTION OF SYSTEM ELEMENTS TO BE TESTED

General

The LOTS main test is broadly designed to support both the common-user type LOTS terminal operations and the related requirements of a Navy/Marine Corps amphibious follow-on operation. Both of these activities involve commercial type ships provided through the Military Sealift Command and, while there are some system equipment and technique differences resulting from specific service requirements,[4] the fundamental functional elements to perform

[4] Reference is primarily to the constraints in the early support phases of amphibious operations necessary as a result of tactical considerations and the means by which they normally deploy. Most support for amphibious operations has historically been moved in specially configured ships organic to amphibious forces while the deployment of Army LOTS equipment must employ commercial type ships.

the LOTS task are practically the same for both. Based on these similarities only, the LOTS test will involve the types of operations depicted in Table 5. The assault phase of an amphibious operation is conducted in a high threat environment and is outside the definition of a LOTS operation. Therefore, it will not be played. The amphibious forces follow-on phase depicted in this exercise is not conducted in a high threat environment. It subsequently transitions into a joint Army-Navy operation.

The LOTS Test Feasibility and Definition Study categorized the LOTS system configuration as follows:

- Ships to deploy LOTS system equipment and personnel
- Crane subsystem for ship off-loading
- Lighterage subsystem for ship-to-shore movement
- Shoreside unloading subsystem
- Beach staging and clearance subsystem
- Management and control system.

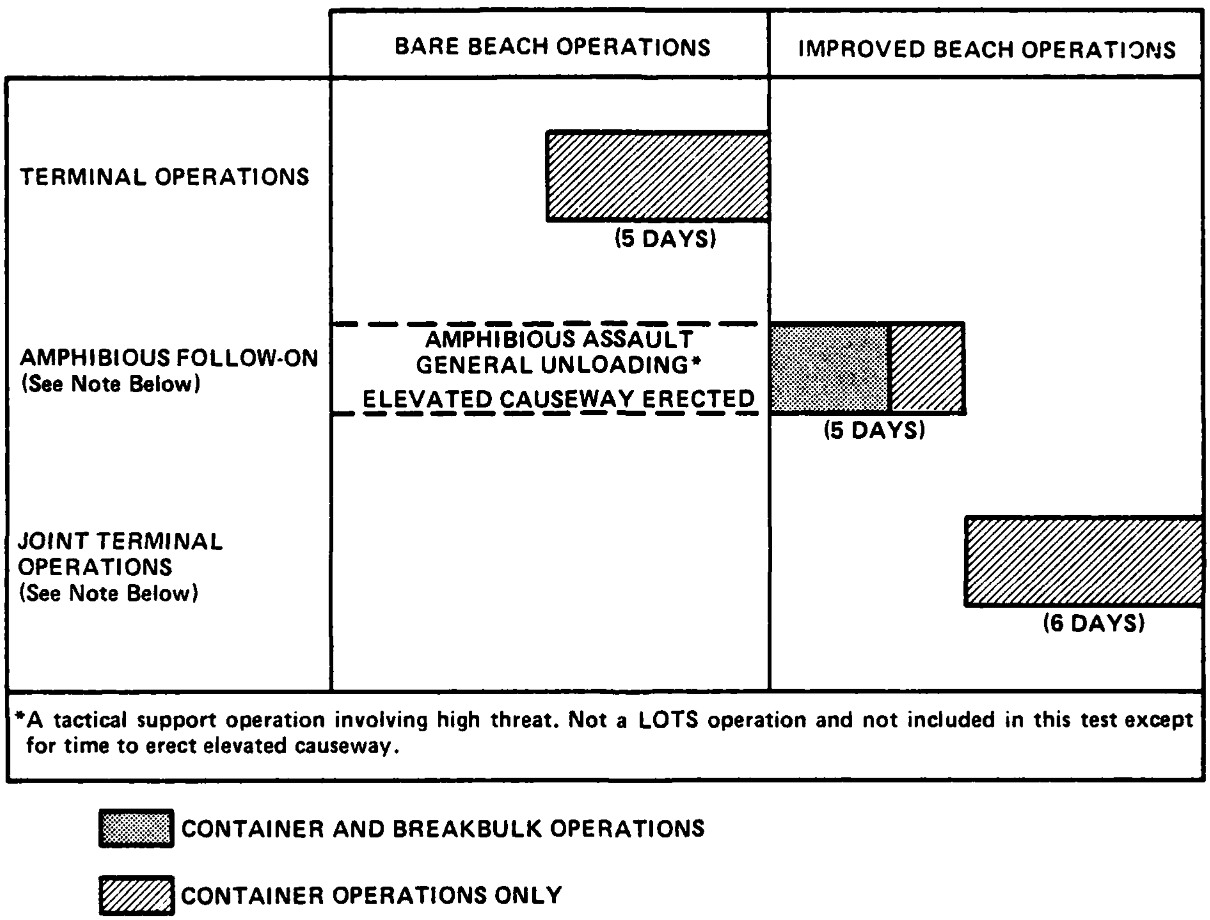
These system configurations available for testing encompass the areas of deployment, throughput, and shoreside distribution activities. This section primarily addresses the throughput phase and the specific elements of that phase which are to be tested. Because the throughput phase is the most complex, the test has been structured to concentrate its evaluation in this area. In this regard, the effectiveness of each element of the throughput system is primarily meaningful with respect to its relationship to the remainder of the system; that is, the slowest elements will limit the throughput rate of the overall system. Thus, a key objective of the test will be to stress elements individually as well as collectively wherever and whenever possible to determine the weakest links and to learn where further improvements and refinements may be required.

For best evaluation results, system elements must operate realistically and in their most efficient manner. Similarly, system elements must mesh smoothly with other components where appropriate. Back-up procedures and equipment (discussed in detail later) must be available when situations arise which threaten to interrupt or actually halt operations.

It is anticipated that the integrated use of different Service assets to support throughput requirements will be both necessary and desirable. The commonality of many items, such as LCUs and LCM8s, helps ensure that sufficient resources are available to conduct the test without interruption in any phase and simplify data management. Service roles and missions within the boundaries of the test will not be evaluated, but Service capabilities and planning factors associated with LOTS equipment and support operations will be. In addition, because of the fundamental similarities of equipment and operational procedures and the structure for data collection and reduction methods, it is anticipated that the results can be extrapolated for use in future Service planning and studies.

TABLE 5

OVERVIEW OF OPERATIONS SCHEDULED FOR THE JOINT LOTS MAIN TEST



NOTE: BARGE OPERATIONS WILL BE CONDUCTED PRIOR TO AND AT THE END OF THE AMPHIBIOUS FOLLOW-ON PHASE AND AT THE END OF THE JOINT TERMINAL OPERATIONS.

Containership Discharge/Backload (Crane Subsystem)

General. Both the TCDF and COD options will be employed throughout the LOTS test. Conceptually, limitations on deployment of the TCDF could delay its introduction into the LOTS operation. The TCDF's arrival will depend upon the availability of a very limited number of specialized commercail ships or the amount of time necessary to tow it. The analysis of crane availability will be separately addressed. For this test, however, both types of crane systems will be used concurrently for all discharge and backload operations. This will maximize data collection on both systems. A detailed description of recommended and highly important procedures for the concurrent use of the COD and TCDF on the same containership is contained in Appendix E.

To expedite exercise backloading requirements the JTD should consider supplementing the TCDF and COD with the use of the BD/YD floating crane. (See discussion under "Back-up and Contingency Considerations" which follows.) If containers can be retrograded at a rate of 300 per day, no supplementary loading support will be required. However, it is important that the ships be quickly reloaded so that the next phase of the test can be initiated. An exception to this would be the simultaneous discharge/retrograde throughput objective wherein it is preferable to employ only the TCDF and COD. Retrograde shortfalls in this situation could subsequently be recouped by use of the back-up crane when only backloading operations are in effect. In those instances where the back-up crane is used to supplement the other cranes, it will be necessary to provide additional troop stevedore support.

Crane-On-Deck. The preferred type crane, based on COD analyses accomplished by the Naval Coastal Systems Laboratory (NCSL), is a 225-ton for a typical crane of this size and capacity. (For the test, however, a contract was won by a firm which will provide a 200-ton capacity crane that approximates the below characteristics and capabilities.)

TABLE 6

GENERAL CHARACTERISTICS OF A TYPICAL 225-TON CAPACITY CRAWLER CRANE

Basic Machine Weight (incl. 135,000 lb counter weights)		360,270 lb
Length (without boom base)		38 ft 11 in.
Length (with boom base)		73 ft 11 in.
Width (for transportation)		18 ft 7 in.
Width (for operations— tracks extended)		21 ft 1 in.
Tailswing (for operations)		24 ft 7 in.
Height (for operations, boom not included)		30 ft 4 in.
Height (for transportation)		14 ft 10 in.
Lifting capacities (with 90-ft boom) at:		
	25 ft	229,980 lb
	60 ft	66,840 lb
	90 ft	38,650 lb

A crane of this capacity offers two particular advantages with respect to unloading flexibility. First, by placing the crane on the centerline of the containership, it can off-load containers to either side of the ship, thus eliminating delays incurred while a full lighter clears the ship and an empty one is being moored. Instead, while lighters are being exchanged on one side, the COD can shift operations to the opposite side of the ship where an empty lighter will already have been moored. Also, a crane this size on the centerline can work hatches on both sides of the ship, thus reducing the number of moves required by a COD in the ship's discharge. Based on an analysis of a computer simulation, the net effect on productivity of this crane as opposed to one of, say, 160-ton capacity that could work only one ship-side at a time, is about 35 percent improvement.

In order to use the COD option it is necessary to spread the weight of the crane to strong points on the ship. This is done through the use of a hatch bridging kit developed as part of the Container Off-Shore Transfer System (COTS) program. The kit is rugged and simple in design and consists of two beams each fabricated from large I-beams. Each beam is placed parallel to the long axis of the ship. The two beams provide trackage upon which the crane operates over the hatch square. A second set of beams is individually placed in front of (or behind) the crane so that it can move forward (or aft). The basic characteristics of the kit are contained in Table 7.

TABLE 7

CHARACTERISTICS OF A HATCH BRIDING KIT
(Each Track Beam)

Length	43 ft
Width	4 ft 2¼ in.
Height	3 ft
Weight (each beam)	36,000 lb

COD operations must take into account the fact that some rerating of crane lifting capacity will be necessary. Considerable study has been accomplished in this area by NCSL. The preliminary results indicate that if the crane is properly tied down (to the hatch bridging kit which is attached to the deck), a certain amount of derating is possible for operations in a calm seaway. Under these conditions the crane is capable of operating near its land limits. This capability is also affected by the amount of pendulation experienced with the load and, therefore, to the use and effectiveness of automatic taglines. Both tagline functions and crane derating are areas that will receive detailed examination as part of the COTS program.

Temporary Container Discharge Facility. The second crane subsystem available for containership unloading during the LOTS test is the TCDF, in this case an Army P&H 6250 truck-mounted crane that has been loaded on a "B" DeLong barge. This particular TCDF was tested as an adjunct to the LOTS Heavy-Lift Breakbulk Ship Pretest. During the pretest it off-loaded 20 milvans (20-ft) and one 40-ft container that had been weighted with sand. Experience with this element of the system is still limited but more practice is expected before the test. Some techniques have been learned such as placing the crane as near perpendicular to the containers being unloaded as possible so that the container spreader bar when lowered is not at an angle over the container. Otherwise there are extensive delays and more manpower is required to wrestle the bar and container alignment.[5]

Operationally, the TCDF will work the opposite end of the ship from the COD. Cargo will be stowed aboard the ship to be representative of a realistic load, i.e., even though only at 2/3 capacity. The number of containers above deck and in each cell will be proportional to the stowage plan used if the ship were fully loaded. It is not envisioned that the TCDF would be used to off-load any deployment cargo since the deployment phase would likely be completed prior to the arrival of the TCDF. However, time permitting, test lifts of equipment items by the TCDF will be made.

Ship to Shore Subsystem

Lighterage support will primarily consist of the use of LCM8s and LCUs. Lighterage is the most common element between the Army and Navy with three notable exceptions. The Navy has the only causeway ferry capability[6] and the Army has the only air cushion vehicle. (Results of these two lighterage exceptions are of interest to both since the Navy has an on-going air cushion vehicle program. Also, the Army has expressed some interest in the causeway ferry approach to lightering.) One other exception is the use of amphibians for cargo transfer; the Army has three versions of the LARC (the LARC-V, LARC-XV, and the LARC-LX) whereas the Navy has only the smallest (LARC-V) and does not intend to add the larger versions to its inventory.

Navy lighterage resources to support the elevated causeway (discussed subsequently) are insufficient due to deployment commitments. This gap will be bridged by tasking Army LCU and LCM8 units for resources. Conversely, extending the use of Navy lighterage to cover the entire test period will provide some opportunities to examine support capabilities of the 1646-class LCU in sustained round-the-clock operations.

In the bare beach phase where tidal effects hamper the beaching of landing craft, it is anticipated that amphibians will be used extensively.

---

[5] One of the data elements for collection should include the TCDF positioning angle with respect to the container being off-loaded. See Section III for further details.

[6] The Army use of BC barges as lighterage is not considered in the same category because of the inability to drive equipment on and off.

Their employment will require particular attention to ensure that LARC-XVs and LACV-30s are not overloaded. To maximize transportation efficiency, it would be desirable for the LARC-LXs to lighter the heaviest containers. Also, to maximize the employment of amphibians, it would be desirable to off-load them near the beach versus at the marshalling site, thereby increasing the number of containers lightered per hour per vehicle. Although amphibians have the capability to transport containers from the beach to the marshalling site, the longer land distance greatly increases turnaround time. Trucks, for example, can more efficiently perform the land movement. With limited amphibian assets and with their associated high maintenance costs, it would be prudent to limit their use to those functions the amphibians do best, that is, crossing through the surf zone and loose sand to a cargo transfer point.

The causeway ferry, of which only one has been projected as being available during the test, currently is the primary Navy/USMC method of container lightering until the construction of an elevated causeway has been completed and extensive use of LCM8s and LCUs is possible.[7] It is generally employed along with a frontend loader on the beach. Its availability in a LOTS-type environment is keyed to Service ownership and means for deployment. Deployment of causeways is possible on a conventional breakbulk ship but the number that can be loaded has not been determined. Deployment on amphibious ships does have an impact on cargo space but normally causeways are available to support their off-loading. Accordingly, it would not normally be available for use in what may be described as an Army bare beach effort.

In addition to lighterage requirements for containers there is also a requirement for lighterage to support breakbulk operations. No special type lighterage is required but the capability to support the concurrent off-loading of both containers and breakbulk cargo will be needed.

Shoreside Unloading

General. In the test the Army LOTS terminal battalion and USMC Logistic Support Element must be capable of handling both containerized and breakbulk cargo concurrently. This test requirement applies during the bare beach phase of the test for Army terminal service units and during elevated causeway operations for the amphibious forces. The equipment needed to support these separate functions must be made available for the conduct of each operation.

Bare Beach Operations. Establishment of the bare beach shoreside unloading system will be time-constrained. Initial preparations will be begun by advance parties and engineer units in accordance with deployment scheduling outlined previously and in Appendix B. Once the breakbulk ship with the LOTS equipment embarked has anchored, 4 days will be available to prepare the beach for container throughput operations.

---

[7] The Marine Corps intends to employ an experimental vehicle, the lightweight amphibious container handler (LACH), which may permit some early employment of LCM8s and LCUs before the elevated causeway is available.

Shoreside unloading operations in the bare beach mode will be exercised for a period of 5 days. During this time, cargo throughput will be accomplished as indicated in Table 8. Army transportation unit landing craft, amphibians,[8] and other lighterage deployable on conventional and heavy-lift breakbulk ships will be used. The last day of the scenario will include a period in which the containership is backloaded in time for the next phase of the test, Improved Beach for Amphibious Forces, which will not include the use of 40-ft containers.

TABLE 8

BARE BEACH OPERATIONS

	Test Day				
	T + 13	T + 14	T + 15	T + 16	T + 17
	Non-Mobilization Scenario Day				
	D + 28	D + 29	D + 30	D + 31	D + 32
Heavy-Lift Breakbulk Ship	Discharge 150 S/T Cargo, 75 Drums / LCM Amph.	Discharge 300 S/T Cargo, 150 Drums / LCM Amph.	Discharge 150 S/T Cargo, 75 Drums / LCM Amph.	Backload 150 S/T Cargo, 150 Drums / LCM Amph.	Backload 300 S/T Cargo, 150 Drums / LCM Amph.
NSS Containership	Discharge 150 Containers & Equip. (incl. 25 40-ft Cntnrs. / Amph. Landing Craft	Discharge 300 Containers / Amph. Landing Craft	Discharge 150 Retrograde 150 Containers / Amph. Landing Craft	Retrograde 300 Containers / Amph. Landing Craft	Discharge 50 Retrograde 175 Containers / Amph. Landing Craft

Note: Quantities shown are for planning only. Backloading will commence in time to insure beginning next phase on schedule.

Principal items in the Army shoreside container handling inventory are the 300-ton capacity crane for unloading landing craft and the 140-ton crane for unloading amphibians. The employment of amphibians and a 140-ton crane is rather straightforward but several alternative ways of operating the 300-ton crane at the beach have been proposed. Further discussion of these alternatives and the crane problem is contained in Appendix C. The objective for whatever method is employed is to attain maximum container throughput. The expected result of the method adopted for handling containers is a capability equivalent to the daily off-loading rates of the ship unloading system (disucssed above) of 300 containers per day.

[8] Although both are amphibians, it is expected that the LACV-30 and the LARC-LX will be used to support containership operations only. The quantities of both now available are limited and data on their use with containers is important. Other amphibians can be used to transport breakbulk cargo.

Preparation of beach routes, loading sites, and the marshalling area also will be time-constrained by the amount of equipment and number of personnel deployed in accordance with the scheduling and "sorties" discussed previously. However, the 4 days following the arrival of the heavy-lift breakbulk ship are sufficient to complete off-loading and any additional site preparation not possible with the limited equipment deployed with the advance party.

Improved Beach for Amphibious Forces

To support amphibious force follow-on container and barge handling operations, the mainstay for beach operations is the elevated causeway. The elevated causeway will have been erected prior to arrival of the containership. Data will be collected on its installation making note of times, numbers of personnel required, delays, and level of training and training activities which would influence extrapolation of results.[9]

Operations using the elevated causeway and LACH are relatively straightforward. The first 3 days (T+17 to T+19) containers will be off-loaded and then 2 days of backloading will begin. In addition to container handling, 600 short tons of breakbulk cargo and 300 drums of (simulated) POL will be off-loaded from the heavy-lift breakbulk ship at a rate of approximately 300 short tons and 150 drums per day. Table 9 illustrates the proposed scheduling and employment of lighters.

TABLE 9

IMPROVED BEACH OPERATIONS FOR AMPHIBIOUS FORCES

	TEST DAY				
	T + 18	T + 19	T + 20	T + 21	T + 22
	MOBILIZATION SCENARIO DAY				
	D + 58	D + 59	D + 60	D + 61	D + 62
Heavy-Lift Breakbulk Ship	Discharge* 300 S/T Cargo, 150 Drums / LCM8	Discharge 300 S/T Cargo, 150 Drums / LCM8	– / –	– / –	– / –
NSS Containership	Discharge Containers / C/W Ferry Landing Craft	Discharge 250 Containers / C/W Ferry Landing Craft	Discharge Containers / C/W Ferry Landing Craft	Retrograde Containers / C/W Ferry Landing Craft	Retrograde containers** / C/W Ferry Landing Craft

* Amount of cargo is dependent upon lighterage availability. Priority will go to container throughput.

** At least 400 but not more than 450 containers will be required for the commencement of the Terminal Operation Phase.

[9] Because development of the elevated causeway has been done on the West Coast, units in the LOTS test have had only limited exposure to elevated causeway operations.

During this phase SPS procedures will be exercised by Army units to monitor container and breakbulk/drummed cargo throughput for data collection purposes only. The primary means of cargo control and movement will be provided by a Marine Corps Marine Support Element.

One SEABEE and three LASH barges will be unloaded over the elevated causeway by Navy-Marine Corps assets independent of but during the Bare Beach Phase on a non-interferring basis. This will permit the early retirement of most Marine Corps personnel from beach operations after completion of Phase II. Some Marine Corps elements will remain in the objective area to act as a consignee for containerized cargo.

Improved Beach for Terminal Operations

The improved beach for terminal operations phase of the test will use all Army items of equipment which would be available in a mobilization situation. For exercise purposes the scenario begins at D+58 and assumes that whatever shipping was required from the U.S. flag fleet to support deployment was available.

The principal item in this type operation is the "B" DeLong pier with a 140-ton crane mounted on it. In reality, two DeLong piers placed end-to-end from the beach will be required for the crane to operate far enough seaward so that landing craft do not ground out before they are close enough to be unloaded. Installation of the DeLong piers will begin on T+17 and they will be ready for operations on T+18. The DeLong will be used as a back-up for the elevated causeway in the event a causeway casualty threatens a prolonged disruption of throughput. Then the DeLong will be used to expedite container backloading by augmentating the elevated causeway.) Once all containers have been retrograded, the elevated causeway will be used for unloading the SEABEE barge and all container throughput will be directed over the DeLong piers.

In the final days of the improved beach phase both the elevated causeway and "B" DeLong Pier will be operated together. During this period the back-up crane for the ship unloading system, a BD floating crane, will be worked along with the TCDF and COD to the extent possible to attain a maximum containership unloading rate. See Table 10.

Subject to test days lost due to adverse weather and ship availability, this period may be extended from 1 to a minimum of 4 days. The purpose of this exercise period will be to attempt to overload the two shoreside unloading systems with containers, initially individually and secondly together, to determine what the maximum handling capacity of the system is. The remaining SEABEE and three LASH barges will be moored in a "standby" status. Should interruptions in the container source from the ship be experienced and shoreside facilities are affected, then the barges will be introduced for unloading. If no container source problems occur, the remaining barges will be off-loaded after container operations have ceased and the terminal operations phase has ended.

TABLE 10

IMPROVED BEACH FOR TERMINAL OPERATIONS

	Test Day						
	T + 23	T + 24	T + 25	T + 26	T + 27	T + 28	T + 29
	Moblization Scenario Day						
	D + 63	D + 64	D + 65	D + __	D + __	D + __	D + __
NSS Containership	Discharge 300 Cntnr to DeLong Pier / Amph. Landing Craft C/W Ferry	Discharge 150 Cntnr to DeLong Pier; Retro 300 Cntnr from Elevated C/W and DeLong Pier (25 40-ft cntnr incl.) 3 cranes at ship. / Amph. Landing Craft C/W Ferry	Maximum Discharge to both shore-side systems; use 3 ship cranes* / Amph. Landing Craft C/W Ferry	WEATHER DAY #1	WEATHER DAY # 2	WEATHER DAY #3	—
1 SEABEE and 3 LASH Barges	ON STAND-BY STATUS						Discharge if not previously done.

* See scheduling changes if weather days are not used; paragraph on "Weather Days" pertains.

Management and Control System

Manifest data will be received and processed by the transportation terminal battalion documentation section using the DASPS computer facility at the log base (Ft. Eustis, Virginia) which is linked via AUTODIN to the mobile SPS van terminal in the LOTS area. The manifests will consist of real and exercise cargo traffic transmitted by Eastern Area MTMC to the computer at Ft. Eustis.

As a part of the daily planning for receipt and onward movement of cargo, a Corps Support Command (COSCOM) Materiel Management Center (MMC) and a COSCOM Movement Control Center (MCC) and a beach Transportation Movement Office (TMO) will be played by Headquarters, 1st Corps Support Command personnel. The MCC in coordination with the MMC will provide the Terminal Battalion, through the TMO, diversion and reconsignment instructions, changes in movement priorities, and specify clearance modes (in this case, all highway) for shipment to consignees.

All vehicles clearing cargo from the beach to and from the marshalling area will have proper documentation. TCMDs, properly completed, will accompany all shipments to consignees. The terminal battalion documentation section will maintain records required in accordance with MILSTAMP and unit SOP's.

PRETEST AND LOTS SIMULATION MODEL RESULTS

Preliminary Field Test Data

For deployment planning, the times required for the onloading of equipment in port, off-loading into lighters off-shore, and establishing a cargo/container handling capability ashore have been verified in the conventional and heavy-lift breakbulk ship pretests. Adequate time has been provided for that phase of the test design (See Figure 1).

LOTS Simulation Model Results

Having verified the times required to physically deploy major LOTS equipment items within scenario constraints, the next step was to determine if the available LOTS subsystem assets (cranes, lighters, trucks, etc.) could sustain planned throughput rates. For this purpose data on the capacities and capabilities of LOTS subsystem elements were input to the LOTS simulation model. For sensitivity analyses, ship-to-shore distances, lighter and truck speeds, and mix of lighters were varied. To the extent possible, considering the limited number of amphibian vehicles available, a "best" mix of available craft was determined to accomplish 300 containers per 20-hr day. Summaries of these runs are as shown in Tables 11, 12, 13, and 14. For a detailed discussion of the model runs and test results, see Appendix D.

TABLE 11

SIMULATION RESULTS FOR THE BARE BEACH OPERATION

Lighters					Distance of Ship Off-Shore	Computed Time to Discharge 300 Containers (hr)
Amphibians			Landing Craft			
LACV-30	LARC-LX	LARC-XV	LCM8	LCU		
1	3	0	6	0	1	17.5
1	3	0	0	4	1	18.3
1	3	7	0	0	1	18.4
1	3	0	12	0	3.3	19.9
1	3	0	0	8	3.3	19.9
1	3	16	0	0	3.3	19.9

TABLE 12

SIMULATION RESULTS FOR THE IMPROVED BEACH FOR AMPHIBIOUS FORCES

Lighters			Distance of Ship Off-Shore (nmi)	Computed Time to Discharge 300 Containers (hr)
Causeway Ferry*	LCM8	LCU		
1	2	7	1	18.7
1	2	11	3.3	19.6

* Four causeway sections.

TABLE 13

SIMULATION RESULTS FOR THE IMPROVED BEACH FOR TERMINAL OPERATIONS

Lighters			Distance of Ship Off-Shore (nmi)	Computed Time to Discharge 300 Containers (hr)
Causeway Ferry*	LCM8	LCU		
1	4	4	1	17.9
1	6	6	3.3	18.9

TABLE 14

TRUCK REQUIREMENTS FOR BEACH CLEARANCE

Truck Speed (mph)		Number of Containers Per Truck	Number of Trucks
Empty	Loaded		
10	10	1	10
10	10	2	8
20	15	2	6

BACK-UP AND CONTINGENCY CONSIDERATIONS

Since the overall test involves substantial expenditures of resources, its successful completion should not be jeopardized by such contingencies as storms, breakdowns of essential equipment, or absence of key personnel. These are foreseeable and their effects can be minimized with appropriate planning. This section outlines some of the considerations for an affordable "insurance" program to cut down the impact of possible contingencies.

Weather Days

The test plan makes allowance for days in which test operations must be curtailed or terminated because of weather effects. In the event that curtailment is necessary, make-up or weather day(s) may be added to complete the scenario evaluation. Equal priority for testing and evaluation will be given to the three phases to satisfy DDR&E and, to the extent possible, Service test objectives.

In the event weather days are not used or only partially used, Table 15 provides alternative container unloading objectives. The alternatives are aimed toward providing a three-crane maximum discharge rate to each improved beach unloading system to determine its saturation rate. During this period if queuing builds too rapidly, LACV-30s will be directed to a shoreside crane to reduce the backlog and provide a basis for stressing marshalling area capabilities. If redirection of the LACV-30 does not relieve the queuing sufficiently, other amphibians or the causeway ferry may be used to bring the system back into balance without slowing or stopping the ship unloading system. Each weather day alternative in Table 15 terminates with a maximum discharge to both improved beach facilities working together. (See "Improved Beach for Terminal Operations," page 25.)

Sea state is the most likely cause of weather delays. How much operations may be curtailed and to what degree ship unloading, lighterage, and shoreside unloading systems are affected by worsening sea states are all important elements of the evaluation. A significant weather change at any point in the exercise will permit an evaluation of its impact on ship unloading methods (COD and TCDF), lighter resources, and whatever shoreside unloading method being used at the time.

During the test periodic daily weather and sea state forecasts and severe weather warnings must be available to the JTD and promptly distributed to operational command and evaluation personnel. Forecasts can provide time for the JTD to plan and execute changes in operations. A series of alternative schedules will permit each unloading svstem to be activated during the heavy weather condition so that data can b[illegible]llected. It would be desirable to accomplish at least 40 iterations with each system so that statistical realiability of the data will be relatively high. On the other hand, a forecasted period of severe weather may not permit sufficient time for each system (crane-on-beach, elevated causeway, and DeLong pier) to conduct 40 unloading iterations. To the degree possible it is better to exercise each system proportionately rather than obtain no data at all on one of them within the severe weather period.

TABLE 15

UNLOADING OBJECTIVES FOR UNUSED WEATHER DAYS

WEATHER DAYS AVAILABLE	OPERATING SCHEDULE					
	T + 24	T + 25	W – 1	W – 2	W – 3	T + 29
All Weather Days Used. (No change from Figure 1.1)	325 Cntnrs ABD Discharge 150 Cntnrs to DeLong Pier; Retrograde 300 Cntnrs from DeLong and Elevated Causeway	475 Cntnrs ABD Maximum Discharge to both Systems				Off-Load Crane; Inspect Ship
Two Weather Days Used-- One day gained for operations.	325 Cntnrs ABD 3-Crane discharge of 200 Cntnrs to DeLong; Retrograde 250 Cntnrs from Elevated Causeway & DeLong	375 Cntnrs ABD 3-Crane discharge of 200 Cntnrs to Elevated Causeway; Retrograde 250 Cntnrs from Elevated Causeway & DeLong	450 Cntnrs ABD Maximum Discharge to both Systems			Off-Load Crane; Inspect Ship
One Weather Day Used-- Two days gained for operations.	325 Cntnrs ABD 3-Crane discharge of 200 Cntnrs to DeLong; Retrograde 250 Cntnrs from Elevated Causeway & DeLong	375 Cntnrs ABD 3-Crane discharge of 200 Cntnrs to Elevated Causeway; Retrograde 250 Cntnrs from Elevated Causeway & DeLong	425 Cntnrs ABD Retrograde 200 Cntnrs; Maximum Discharge to both Systems	375 Cntnrs ABD Maximum Discharge to both Systems		Off-Load Crane; Inspect Ship
No Weather Days Used-- Three days gained for operations.	325 Cntnrs ABD 3-Crane discharge of 200 Cntnrs to DeLong; Retrograde 250 Cntnrs from Elevated Causeway & DeLong	375 Cntnrs ABD 3-Crane discharge of 200 Cntnrs to Elevated Causeway; Retro 250 Cntnrs from Elevated Causeway & DeLong	425 Cntnrs ABD Retrograde 200 Cntnrs; Maximum Discharge to both Systems	225 Cntnrs ABD Retrograde 350 Cntnrs; Maximum Discharge to both Systems	475 Cntnrs ABD Maximum Discharge to both Systems	Off-Load Crane; Inspect Ship

In order to plan for such contingency schedules special forecasts of sea state must be arranged. Additionally, attention should be paid to forecasts of cessation of high sea states after the exercise has been temporarily shut down. Experience in OSDOC II (and historically in past over-the-beach operations) indicates that resumption of work has lagged unnecessarily far behind a return of reasonable sea states.

In an actual LOTS operation a cessation of throughput activity due to weather provides additional time for needed maintenance of equipment and for rest. In this exercise similar use can be made of the time along with appropriate adjustments in LOTS assets to reduce system bottlenecks.

Because of overriding safety considerations, the decision to continue or to cease operations during heavy weather conditions is reserved for the JTD Commander.

Back-Up Equipment to Ensure Throughput

The exercise cannot be put in jeopardy from the breakdown of single items of equipment or from other conditions that might prevent its effective use. At the same time, it would not be appropriate to go to the expense of providing back-up or alternatives for all equipment. A judicious choice of back-ups and alternatives must be made that will cover the most likely and, to some extent, the most drastic of the foreseen contingency possibilities. In general, special attention must be given to throughput bottlenecks. Table 16 illustrates the employment of cranes and their back-up support through each phase of the test. Other back-up equipment requirements anticipated by the Services should be coordinated with the JTD.

TABLE 16

CRANE EMPLOYMENT SCHEDULE

		Scenario-Related Crane Employment			
Crane Resources		Crane Support For Bare Beach Operations	Crane Support Of Improved Beach For Amphibious Forces	Crane Support Of Improved Beach For Terminal Ops	Crane Support For Improved Beach—All Major Facilities
Ship Unloading					
Crane No.	LOTS Function				
1.	Crane-On-Deck	No. 1	No. 1	No. 1	No. 1
2.	Temp Cntnr Dschg Facility	No. 2	No. 2	No. 2	No. 2
3.	BD/YD Crane (Backup)	(as required)	(as required)	(as required)	No. 3
Shoreside Unloading					
4.	300T Crane-On-Beach	No. 4	(inactive)	Marsh. Yd.	Marsh. Yd.
5.	140T Amphibian Loading Crane	No. 5	Back up No. 7	Back up No. 7 and Marsh. Yd.	Back up No. 7 and Marsh. Yd.
6.	140T DeLong Pier Crane	(not available)	(inactive)	No. 6	No. 6
7.	140T Crane-On-Causeway (leased)	Back up No. 5	No. 7	(inactive)	No. 7
8.	LACH	(inactive)	No. 8	(inactive)	(inactive)

Ship Unloading Cranes. A back-up is needed in case the crane-on-deck or the TCDF crane become inoperative for long periods of time. While conceivably the crane-on-deck could be replaced by a second crane-on-deck, the time required for the substitution would be prohibitive. For the TCDF a crane substitution could perhaps be accomplished more quickly but this delay and its replacement's potentially lesser productivity could delay the exercise or reduce throughput by 50 percent or more. Although not a completely satisfactory back-up for either of the two cranes, a floating crane of sufficient reach and capacity should be available. Presumably, it would generate less throughput than either of the cranes it would temporarily replace, but it would permit continued testing of other system components at reduced throughput rates. In addition, the floating crane will be able to augment the TCDF and COD during retrograde operations. It can also be used in the final phase when an attempt will be made to stress the two major shoreside unloading facilities by accelerating ship unloading.

Shore Cranes

Two back-up cranes will be needed to support shoreside unloading, a 300-ton and a 140-ton crane. Since the Services do not have these additional assets, both will have to be leased. Positioning of these cranes should be such that they will be out of the way of other beach activities but still can replace the deadlined crane with minimal time losses. Thus, road approaches and ramps should be readied in anticipation of need. This requirement should also encompass some available back-up means to reposition the deadlined crane in the event it becomes immobile.

One crane must be relocated to meet the diverse scenario and crane requirements in the relatively short time available. Initially a 140-ton crane is needed at the beach to unload the LARCs and LACV-30s. During Phase II this crane must relocate to unload the amphibians in the marshalling area beginning with Phase III.

Lighters

Operational bottlenecks caused by inoperability of individual lighters (except LACV-30) are not critical to cranes because the total work load of lighters is shared— they operate in parallel. For the test, however, certain conditions make back-up considerations for lighters important. One is an operational problem during the bare beach phase due to sandbars at Red/Blue Beach. Sandbars may limit landing craft operations to periods near high tide. Then amphibians have to be relied on for a large share of throughput. Potentially, the most productive amphibian vehicle is the LACV-30 and there are only two of them on-hand. Thus, all other available wheeled amphibians may be called on as a back-up for greater-than-planned use. Provision for substantial numbers of back-up amphibians is appropriate. Investigation of the possible use of a reserve unit for this back-up role is encouraged.

Another back-up possibility for the bare beach sandbar contingency is to have Navy-type causeway ferries on-hand. The ferries are known to be in short supply. However, if feasible, arrangements should be made for loads from Navy operational units for emergency use during the test. Also, if available, AMMI barges should be considered for standby use.

SITE SELECTION

Test Site

Ft. Story, Virginia was originally selected for the LOTS preliminary field tests and main test based upon the following criteria:

- Proximity to majority of participating units.
- Proximity to major commercial ocean terminals (access to commercial test vessels).
- Continguous to or immediate vicinity of military post for administrative/logistic support.
- Beaches at least ½ mile in length, 300 ft in depth, with at least two access roads.
- Off-shore anchorages of 50-ft depth with varied, representative, moderate sea conditions. Proximity to sheltered anchorages for adverse weather safe haven.
- Twenty-five to thirty acres of relatively open, flat area for cargo marshalling, equipment operation, and command and control facilities.
- Beach gradient suitable for both landing craft and amphibians.
- Proximity to aviation support facilities.

In a final review following completion of the preliminary field tests (April-November 1976), Ft. Story remained the best choice although the beach gradient and presence of sandbars were a serious obstacle for beaching container-laden landing craft within reach of a crane on the beach (discussed in Appendix C).

Beach Site

As noted in the LOTS Feasibility Study, LOTS operations could be conducted in a wide spectrum of sites from a topographic view. However, from a survey of areas considered strategically important, usable beaches are available for LOTS operations. From the standpoint of beach gradient the great majority (81 percent) of all the usable beaches have gradients flatter than a ratio of 1 to 61. From that standpoint Green Beach at Ft. Story can be considered as typical of landing sites in strategic areas.

During the conduct of preliminary field tests the presence of sandbars off-shore greatly hampered landing craft attempting beach landings except at high tide. The only beaches with better approaches were Red and Blue Beaches, both of which face the Chesapeake Bay. The difference in surf

conditions between the beaches facing the bay versus Green Beach was studied.[10] The conclusion reached was that Green Beach would, on the average, experience high waves and more typically represent an ocean beach than would either Red or Blue Beach, as indicated in Table 17. However, with the sandbars jeopardizing the attainment of most major test objectives, the decision was made to conduct the test over Red and Blue Beaches.

TABLE 17

ANTICIPATED WAVE AND CURRENT CONDITIONS AT CAPE HENRY, VIRGINIA— VICINITY*

	Average		Maximum		Wave Energy Concentration (i.e., Wave Refraction)	Anticipated Tidal Current Activity (Relative)	Maximum Combined Conditions	Relative Speed Of Natural Filling Of Dredged Holes, etc.
	Ht(min)	T(sec)	Ht(min)	T(sec)				
Red-Blue Beach	≥0.5	3-5	2	7	Low (relative to other Southern Bay Beaches) except for winds from North ≥ 25 kts	Higher	Ebb tide, with large swell entering Bay Mouth of strong (≥ 25 kts) winds from northerly quadrants	Lower
Green Beach	≥1.0	6-10	3	12	High (relative to adjacent ocean beaches) for short period waves (4 sec) and relatively low for long period waves except for 10 sec waves from NE thru SE directions; and longer waves from E.	Lower	Large, slow moving, extra tropical storm at spring high tide	Higher (especially with large waves)

* Furnished by Victor Goldsmith, Virginia Institute of Marine Science.

CONTAINER/TEST CARGO REQUIREMENTS

General

The requirements generated for specific cargo loads must be in consonance with the ship's current capabilities. Early and continuous liaison must be maintained with the ships' operators in order to insure that all test objectives are fully attained. Loading plans must be responsive to the test scenario during each test phase and flexible enough to accommodate to change that may result from adverse weather or other problems.

Since the anticipated load for each ship is well within weight and space limitations, considerations must emphasize the optimum use of cargo handling equipment. Whenever possible, cargo should be loaded in a fashion

[10] Victor Goldsmith, Virginia Institute of Marine Science, Letter to Wm. H. Sutherland, ORI, dated 8 December 1976.

to simulate a maximum load in order to fully exploit the shipboard cargo handling equipment.

In order to achieve a high degree of realism in the exercise, containers will be loaded with "live" cargo with a range in weights generally comparable to normal resupply. See Table 18.

TABLE 18

CONTAINER SOURCES AND WEIGHTS

	8 ft x 8 ft x 20 ft Milvans							
	Weight (Short Tons)							
Source	Empty	4-5	6-8	8	10-15	15	20	Total
Richmond Depot						7	118*	125
Mechanicsburg Depot		75	280		25		20	400
Fort Eustis		20		30				50
NSC, Norfolk	25*							25
TOTAL	25	95	280	30	25	7	138	600

*25 will be loaded into barges.

To ensure that sufficient numbers of containers are available to evaluate the full capability of the LOTS system in sustained, around-the-clock operations, a total of 600 milvans and 25 commercial 40-ft seavans will be used. Twenty-five of the milvans will be loaded in four LASH barges.

For breakbulk cargo operations, 600 short tons of palletized exercise cargo and 300 drums of simulated POL will be prepared at Ft. Eustis and loaded on the heavy-lift breakbulk ship. Four LASH and two SEABEE barges will be loaded with a mix of palletized, containerized, and vehicular cargo.

All cargo will be documented/manifested in accordance with MILSTAMP.

Containership

The confirmation of a C573 (LIGHTENING) class ship for the main test has been made. This type of non-self-sustaining containership can be readily utilized to fully exercise both the COD and TCDF concurrently.

This type of ship has nine bays, eight have two hatch covers. Bays No. 1 through 8 are located between the fore and aft deck houses. Bay No. 9 is located at the stern of the ship and has only one hatch cover.

Because it has a capacity of 1,070 20-ft container equivalents and only 600 containers will be loaded, less than two-thirds of the ship will be

utilized. Several variations of cargo distribution will satisfy the test objectives, however, there are some considerations that are applicable to any load. These are:

- Heavier containers should be loaded on lower tiers and in cells closest to the ship's centerline.
- Forty-foot containers cannot be stowed under 20-ft containers.
- The initial above deck stowage on one bay must be reserved for the crane-on-deck.
- Forty-foot containers must be spotted on the highest outboard above deck position to ensure adequate security for sea transit.
- Forty-foot containers should be block-loaded and retrograded in order to minimize spreader bar conversions. Stowage locations should be considered to ensure both the TCDF and COD are alternated during movement operations.
- None of the below-deck bays need to be loaded above the 5th tier. (There are 6 tiers below deck.)
- The COD should be displaced as often as possible without interrupting the throughput.
- Bay No. 9 does not need to be loaded for the initial off-load. Its use, if required, should be in support of a three-crane shipside scenario.

The following items will be loaded in the container (not listed in loading sequence):

- Four flatrack containers with assorted trucks and trailers
- One crawler crane
- Hatch bridging kit components
- Three 8 x 8 x 20 USMC shelters
- Twenty-five 8 x 8 x 40 seavans (20 tons)
- One hundred thirty-eight 8 x 8 x 20 milvans (20 tons)
- Seven 8 x 8 x 20 milvans (15 tons)
- Twenty-five 8 x 8 x 20 milvans (10-15 tons)
- Thirty 8 x 8 x 20 milvans (8 tons)
- Two hundred eighty 8 x 8 x 20 milvans (6-8 tons)
- Ninety-five 8 x 8 x 40 milvans (4-5 tons).

Phase I

The shelters, vehicles, and other LOTS equipment will be off-loaded first. The remainder of the first 3 days will be used for the complete off-load of all containers. All off-loaded containers must then be retrograded back to the ship during the next 2 days. Crane operations and movements at the ship offer many variations. One is described in Appendix E.

Phase II

Both the COD and the TCDF should be employed similarly to Phase I, only in the reverse direction. On the last day of this phase, the BD crane will be stationed at bay No. 9, if required for loading. If feasible, this crane can supplement the loading of bays by the TCDF (on the opposite side). As in Phase I, it is anticipated that the first 3 days will be for off-loading operations and the last 2 days for retrograde. In that the marshalling area (DSSC) will required some containers to remain ashore, not more than 450 milvans will be retrograded for Phase III.

Phase III

All three cranes can be used to maximize the container off-load. Ideally, the BD can commence at bay No. 9, the COD at bay No. 8, and the TCDF at bay No. 4; when the BD completes bay No. 9, it can move to the side of bay No. 4 which is opposite to the TCDF. If time permits, simultaneous retrograde will be conducted in order to maintain an uninterrupted source of containers from the ship.

SEABEE Ship

The use of a SEABEE during the main test is fortuitous. The data collected during the LASH pretest, when added to the main test SEABEE results, should provide more complete coverage of bargeship capabilities in LOTS operations.

The limitations that caused the cancellation of the SEABEE pretest[11] are still in effect. Accordingly, no lift of a DeLong B barge will be attempted. LOTS equipment that will be deployed on the ship include:

- One LCM8
- One LCU (1466-class)
- One LCU (1610-class)
- One causeway warping tug or causeway section
- One LARC-LX
- One LACV-30 (test lift only)
- Two SEABEE barges.

---

[11] Operations Research, Inc., Report on the Cancelled SEABEE Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1148, 15 June 1977.

With the exception of the LACV-30, all cargo will be loaded at NSC, Norfolk and will deploy with the ship to Ft. Story. A test of the LACV-30's compatibility with a modified container adaptor frame will be conducted during the loading period at NSC, Norfolk. Upon completion of the test the LACV-30 will deploy itself to Ft. Story. Immediately upon arrival at Ft. Story, the SEABEE will be off-loaded and released from the exercise. Its ability to load and deliver the test cargo will be closely documented.

The two SEABEE barges will be loaded with vehicular, breakbulk, and containerized cargo prior to deployment. These barges will be moored off the LOTS beaches and will be joined by six LASH barges, similarly loaded and administratively introduced into the exercise via tug.

One SEABEE and three LASH barges will be off-loaded during Phase I at the elevated causeway. Upon completion of off-load, they will be towed to NAB, Little Creek for safe haven. The remaining barges will remain moored and act as floating dumps. Should delays occur at the ship and cargo stoppages are experienced on the beach, these barges can be introduced in an effort to maintain some throughput. If they are not utilized during the test, they will be unloaded at the end of Phase III at the DeLong pier.

Heavy-Lift Breakbulk Ship

This ship will be loaded with most of the vehicular test cargo and all of the breakbulk. This includes:

- 600 pallets of cargo
- 300 dr ms of POL
- Sideloader
- Frontloader
- 140-ton crane
- 300-ton crane
- LARC-LX
- Yard tractor
- Yard trailer
- LCM8
- LCU (1646-class)
- LCU (1466-class)
- BC barge
- Mobile SPS van terminal.

All of the non-breakbulk cargo will be off-loaded first with assembly of the equipment completed by the beginning of Phase I. The breakbulk cargo will be completely off-loaded and retrograded during Phase I. A final off-loading of this cargo will be completed during the first 2 days of Phase II. At this point, the ship will be released from the exercise.

Backloading Operations

Backloading full containers aboard the containership is a test-peculiar requirement that could unduly delay exercise events unless appropriate stowage and movement plans have been prepared. Normally in a LOTS environment, retrograde operations would include few loaded containers. In the joint LOTS test nearly all of the containers will be backloaded with cargo. Since retrograde operations constitute about 40 percent of all container handling and two discharge cycles are dependent upon retrograde operations being completed on schedule, careful planning must be accomplished to ensure a steady flow of containers to the ship in a proper loading sequence.

Approximately 25 percent of the containers will be loaded to near maximum capacity (about 20 short tons). The lightest containers will be loaded with about 5 short tons of cargo. If backloading is not properly accomplished, unsatisfactory conditions could result such as making the ship unseaworthy or causing a list to the extent that no containers can be loaded or off-loaded without considerable difficulty. Accordingly, loading plans need to be developed and adequate control established to ensure that these conditions do not occur.

III. ANALYSIS PLANS AND DATA REQUIREMENTS

KINDS OF ANALYSES PLANNED

The basic objectives of the joint LOTS test require the following principal kinds of analyses:

- An assessment of deployment capabilities
- A validation of throughput planning factors
- An evaluation of the cargo management system
- An evaluation of force structure and manpower utilization.

Separately to a degree, but largely as part of the above, the following kinds of analyses are also part of the work:

- Making productivity analyses and tradeoffs
- Making critiques of techniques and equipment selection
- Evaluating command and control of the operations, particularly with respect to throughput, and
- Unplanned analyses contributing to the above.

The analyses under each of the headings will make use of data and information not only from the test results but also from outside sources such as reports on prior tests. In all of the analyses listed, determining the effects of the environment on test results (particularly sea state) will be a goal.

Assessing Deployment Capabilities

In the main test, and in the pretests made before the main test, only selected samples of the total deployment requirements can be undertaken. In general, the ships selected and the equipment chosen for tests represented difficult deployment problems. They were designed to establish feasibility of deployment for specific equipment and to find limits to weight and size capabilities. In analyzing the overall test results, the results of limit-tests must be put into a quantitative perspective that includes lifts of equipment whose size and weight are well below the established limits. In short, the overall shipping needs—not just the equipment so far sampled—will have to be considered. This analysis can have impacts on the choice of LOTS equipment for a future emergency. The number and types of ships needed, their probable availability, their schedules of arrival at an objective area, and the balance of LOTS equipment they can carry must be considered during such deployment analyses. Broad planning factors on deployment times and manpower needs will be one result of deployment analyses.

The analyses will extend the ship availability information already discussed in the LOTS Pretest Design to greater detail.[1] It will possibly use already-made "snapshot" studies that can show the probability of particular ships being available in specific U.S. ports on short notice during future emergencies. In such studies of availability of ship types as already noted in the LOTS Pretest Design, a sharp distinction is made between those types committed by their owners for nearly immediate use in a declared mobilization emergency and those that may be available for emergencies short of mobilization. Such analyses can have strong impacts on the choice of ship types likely to be available in the two circumstances, and hence on the types of LOTS equipment that can be counted on. For example, it appears highly unlikely that SEABEE ships, of which there are only three currently operating, could be made available early enough in a non-mobilization emergency. With little room for exception, this fact limits the use of the B DeLong barge to mobilization emergencies.

Note that part of the deployment analysis will depend on the thorough documentation of LOTS equipment discussed earlier. Since each operating unit will be required to produce shipping documentation for any major equipment brought to the test site, it should be possible to reconstruct what actual shipping requirements would have been in a real emergency.

Validating Planning Factors

A high-priority part of the analysis of the main test results will be establishing throughput planning factors for the available systems and for equipment and units that work within the systems. Present planning factors for handling containers are generally estimates because the military capability is relatively new and opportunities to measure them in real operations or in tests have been lacking. Hence, many planning factors are simply based on extrapolations of commercial equipment capabilities.

[1] Operations Research, Inc., Design of Preliminary Field Tests for the Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 993, 6 January 1976.

Establishing planning factors is envisioned as a four-step process. The first step is to get timing data for specific conditions timed in the test. Second, it is necessary to determine in what respects an "average" or "to be expected" system differs from the one timed. In this step two aspects are involved. One is correction of artificialities inherent in a test as compared to real lift. An example is the retrograde movement of non-empty containers in a greater ratio to empties than would occur in real life. Corrections for this will be based on the results of timing of empty and full containers during retrograde movement. A second aspect of step two, finding what an "average" system is compared to the one being timed, requires the analysis team to acquire data from sources independent of the test.

Establishing planning factors calls for analysis of both a) the repetitive once-per-lift basic data time required per lift, and b) on data for making lift gear ready, hatch cover moving and the like, which do not occur as frequently as once per lift. (Note that some or most of b) may be repetitive.)

The analysis is planned to establish basic system throughput and throughputs of the various components of the system on a "building block" basis. Factors will be calculated to show adjustments to throughput. One important adjustment would be for sea state, assuming that a sufficient quantity of operations in significant sea states, in fact, occur during the test. Other adjustments to be considered will be for different ship types and sizes, and for different types and quantities of ship unloading equipment.

Evaluating the Cargo Accounting and Distribution System

Keeping track of where each container or other cargo is located at any given time and arranging that it be directed and carried to its appropriate inland destination are necessary functions the LOTS test is intended to exercise and monitor. The analysis of the test results for this area will include assessing answers to questions such as the following:

- Does the system provide a complete "audit trail" as cargo moves from each part of the system to the next?
- Does the system, in fact, account for all the cargo handled with none left out?
- Does the system delay operations and by how much?
- Is the system responsive to changes in such matters as priorities?
- Is there provision for handling misdirected or misrouted cargo from outside of the system being tested?
- At any particular point is there visibility of what is awaiting discharge and on hand (intransit storage)? Can one tell what is the oldest cargo on hand.

- Is the cargo data entered on various control sheets complete and accurate? What are the types and frequencies of errors?

Manpower Utilization and Force Structure

For most units involved in the test TO&Es are current and the manning levels have undergone numerous reviews and up-dates based on experience. The exception is the U.S. Army transportation terminal company (container), a newly organized unit. The joint LOTS test will provide an opportunity to evaluate the manning level of the company in all areas: operations, administration, supply, and maintenance. Daily records will be required to account for the assignment of personnel by type of duty.

With regard to force structure analysis, movement requirements in support of most likely contingency situations will be compared with current LOTS unit capabilities. The numbers of LOTS units by type (with capabilities as validated in the joint LOTS test) to accomplish the currently planned time-phased ship unloading requirements will be determined. As a part of the deployment analysis, an estimate of total shipping requirements needed for these LOTS units to support contingency plans will also be made.

The USMC Marine Support Element will be task organized to accomplish the level of effort envisioned in the test design, but may be constrained by the amount of container handling equipment available. Any shortfalls in container handling equipment must be filled by Army augmentation. Adjustments in personnel or equipment will be recorded as they occur.

Productivity Analyses

All the throughput systems that are to be tested (and some that must be synthesized to correct such artificialities as the single crane-on-deck instead of the two planned for real operations) can be expected to have bottlenecks. In principle, the location of the bottleneck should be controlled by balancing the throughput system, at least to the extent that the resources available and applicable permit. The bottleneck will then be confined to the part of the system that has the most basic limitation. In general, this part will be the ship-to-lighter cargo transfer; other parts of the system would seem to be more readily augmented with parallel operations or their output otherwise increased.

Time data on any one element of a throughput system may well be used to improve the balance of the system. That is, it will be used to show how to eliminate some delays. (Presumably, most of the time not all delays would be eliminated, since that would shift the site of the bottleneck.) The results of the productivity analysis will, of course, be reflected in the throughput planning factors already discussed.

Critiques of Operating Techniques and Equipment Selection

Independent of the productivity analyses, which are addressed to improving overall throughput, there can be improvements or other adjustments to the individual sectors of the system with the goal simply to use less

resources for a given operation. Obvious examples might be: in the analysis a crew size may prove greater than necessary or a crane used may have had a reach substantially greater than needed. Note, though, that the analysis here would be after-the-fact critiques of the use of equipment that has been officially designated as operationally capable for use during military emergencies and is not oriented toward equipment development.

Critiques of Command and Control of Throughput Operations

Not covered in the above are the communications-effectiveness and other aspects of the control of operations during the test. In even the smoothest running and most thoroughly prepared operations various adjustments have to be made as a throughput operation progresses. How quickly the command net responds to needs for adjustments, how well the needs for changes are met, and how various minor emergencies are dealt with must be observed, recorded, and analyzed. Analysis of this topic will clearly use a more subjective approach than some of the other kinds of analyses discussed above.

Unplanned Analyses

Experience indicates that nearly all tests and experiments provide requirements for analyses that were not planned before the tests. Most such analyses will be based on data that is collected routinely by the data takers. There will also be some data collected by skilled observers that can be used for additional analysis requirements.

IMPACTS OF ANALYSES ON DATA REQUIREMENTS

The various types of analyses outlined in the previous section each require data imputs from the test. (While they also require additional information and data from outside the test, discussion of such material is outside the scope of the present report.) This report outlines the way the data needs are derivable from the analysis needs and gives examples. Sufficient material is shown to establish:

- An orderly procedure for showing what data will be required, and

- A tentative requirement for the timeliness, accuracy, and the level of detail of the needed data, so that order-of-magnitude estimates can be made of the tasks involved in collecting, storing, and reducing the needed data.

Kinds of Data Required

In the pretests already accomplished the most basic of the information collected was whether particular equipment could, in fact, be deployed. In the main test the emphasis is changed. The most basic information to be collected is on how long the various operations take. This means that two

Data on wave and platform motion will be collected in a way similar to that used in the tests of the breakbulk ships. Additional platform motion data for the TCDF and/or the crane-on-deck may be collected in conjunction with measurements of crane stresses by COTS program personnel. Data so collected is not part of the responsibility of the test directorate, but any platform motion data available from this research effort should be requested and incorporated in LOTS test data.

Data on waves and platform motions should be presented in the same form as the previous pretest results except for the addition of information in the form of spectral analysis. These data permit possible future comparisons to be made between theoretical predictions of platform motion and actual operations.

Precision With Which Data is Recorded

Time Records. In the pretests, which were primarily concerned with deployment and in which the elapsed times of most concern were substantial fractions of an hour, recording of time to the nearest minute was sufficient. Any errors caused by imprecision of measurement were likely to be only a small percentage of the total elapsed time. Generally, for the main test, this degree of precision continues to be appropriate. For selected throughput analyses, more accurate timing of shorter time segments (e.g., parts of the lift cycle) will be accomplished by ORI personnel on a sample basis. These data samples will serve to validate test results and provide reasonable accuracy for elapsed times that are in fractions of a minute.

Physical Measurements. The precision with which records of distance and weight are to be recorded for the operations depends on the particular operations being studied. For some examples, in ship-to-shore distances, errors in tenths of a mile are accepted and expected. For operations in which a lighter is being loaded, no notation of the available clearances is usually needed since it is available from known dimensions. However, in the event that a previous container has been poorly located, an estimate of available clearance should be recorded by the observer if the clearance, in fact, slows down or otherwise impacts on the operation.

For situations where near-maximum reaches are being made by a crane, careful note of distance to the nearest foot and actual weight (from cargo list or other source) is required to show why a particular lift is marginal or not possible. Except for clearances, timers will normally not be asked to provide estimates of distances. Measurements will be made when necessary by other designated personnel.

Specifications will be made of the accuracy required for foreseen special analysis needs. Otherwise, goals of within plus or minus 10 percent of the actual value of distance or weight recorded should be used as a guide for constructing forms or instructing data-takers.

Increased Detail of Repetitive Data

During the main test, time data on all once-per-lift repetitive cargo transfer cycles will be recorded in terms of six basic elements. Each cycle will show three such elements for the non-load (or empty) half of the cycle and three corresponding elements for the loaded part of the cycle. The basic elements are listed and further defined in some detail in Table 19 but, in short, the lifting device does the following:

Empty

A. Move empty (i.e., move away from previous recently disconnected load toward the new load)

B. Positions itself empty close to new load

C. Connects (i.e., the empty lift device) to the load.

Loaded

D. Moves loaded

E. Positions the load

F. Disconnects from load.

TABLE 19

BASIC ELEMENTS OF CARGO TRANSFER CYCLE FOR CRANES, SHIP BOOMS, FORK LIFTS, AND OTHER MHE

Short Title for Subelement	Description of What is Accomplished During Subelement	Start of Basic Element	and	End of Basic Element
		"Empty" Basic Elements		
A. Move Empty	Lifting device moves from previous load to vicinity of new load (gross movement of lifting device)	Time when lifting device is clear of previous load	to	Time when lifting device is in close proximity to new load to be lifted
B. Position Empty	Lifting device moves from near load to an accurately located position (fine movement of device)	Time when lifting device is in close proximity to new load	to	Time when lifting device is positioned ready to be connected
C. Connect to Load	Loading and lifting device are connected together	Time when lifting device is ready to be connected	to	Time when device is connected and the lift of load begins
		"Loaded" Basic Elements		
D. Move Loaded	Load is moved to vicinity of new location (gross movement of load)	Time when device is connected and lift of load begins	to	Time when load is in the vicinity of new location
E. Position Loaded	Position of load is adjusted (fine movement of load)	Time when load is in the vicinity of new location	to	Time when load is accurately positioned
F. Disconnect Load	Load is disconnected from the lifting device	Time when load is accurately positioned	to	Time when lifting device is clear of load

A few operations in the main test will require that some of the above basic elements be divided into subelements to permit making particular analyses. For example, for analyzing lift truck operations from a causeway ferry to a point on a beach, the "move empty" and "move loaded" elements must be subdivided into "move-on-causeway" and "move-on-beach." This permits the analysis to be used in predictions of throughput for longer or shorter distances on the beach, longer or shorter causeway ferries, and fewer or more lift trucks. During continuing refinement of the data collection plan now in progress these requirements will be developed in coordination with the JTD planning staff.

Specific Samples of Analyses and Resultant Data Needs

Tables 20 and 21 show how two selected samples of analysis can be tied into the needs for data and for data reduction. One shows portions of the data needed for comparing effectiveness of certain lighters, the other shows data needs for a comparison between the crane-on-deck concept and the TCDF. Note that data on the subelements of time discussed above are important for some of the analysis.

Quick-Response Data Requirements

Quick-response information on the test results— particularly throughput results— will be required on a daily basis. The quick look data will form the basis for the initial report and its conclusions, which will be on an overall, rather than detailed, look. Another main purpose of this information is to monitor the progress of the test. Secondary purposes are 1) to provide an assurance that the data is being collected in an appropriate manner— that is, a kind of quality control on the data collection process itself, and 2) as a check on the results provided through the operational reports. Such quick-response data will of necessity be largely unedited.

To monitor the test progress, information must be supplied on what has been accomplished by the system as a whole and by the principal components of the system. The information must be in a form such that the users— the test evaluators— can readily ascertain whether:

- The tests are being performed on schedule.
- The recorded test times are reasonable— that is, whether they at least roughly substantiate rates derived from planning factors.
- All major delays and their causes are recorded.
- The performance data on each system component is properly "tagged" with information on the numerical values of the important parameters that affect it.
- The system is in at least rough balance.
- The essential needs for statistical significance are met. (This requirement can be met by computer calculations of the dispersion of the averages of measured time data.)

TABLE 20

SAMPLE ANALYSES REQUIRED AND IMPACT ON DATA COLLECTING (SERVICE OBJECTIVES 4, 5, AND 6)

Operational Comparison Or Variable Being Studied	Mechanism By Which Variable Affects Operation	Requirements For Data on Dimensions, Equipment Type, ect. (i.e., Non-Timing Data)	Requirements For Non-Repetitive Timings	Requirements For Repetitive Timing Subelements	Needs For Data Reduction
Amphibians and ACV, land craft and associated trucks and cranes		Distance, ship to beach Beach to inshore storage area or transfer point. Kind of going (beach or road)	Seastate of each run, weights for each container Refueling times, frequency maintenance downtimes		
	Docking and undocking (where applicable) Distances, speeds and times		Times to move from ship-to-shore, shore to transfer point, intermediate points.	Detailed repetitive timing of ship-to-shore and shore-to-transfer point required. Breakdown for easy parts of run versus hard parts (i.e., road and beach) on a sample basis.	Net docking and undocking times, rates of speed on water, on land.
	Cargo transfer times	Type, make, capacity of cranes. Number of parts in line. How much space is available for point-of-rest operations when clearance transport is not available (i.e., space available for how many containers	Time for shifts in crane positioning, necessary re-rigging.	Detailed subelement of delays when there is no truck available. Center of gravity problem on ACV requires accurate spotting and "trials" to achieve proper trim.	Containers/tons per hour of transfer time.
	Capacities	For ACV, capacity will be a function of amount of fuel on board. Record of fuel on board at each loading needed.	The ACV may be limited to one container if containers are heavy. Thus the weight for each container must be recorded, as well as amount of fuel aboard.		Curves of fuel consumption rates at different speeds and different weights, over water and over land.

TABLE 21

SAMPLE ANALYSES REQUIRED AND IMPACT ON DATA COLLECTING (SERVICE OBJECTIVES 3.1 THROUGH 3.7)

Operational Comparison Or Variable Being Studied	Mechanism By Which Variable Affects Operation	Requirements For Data on Dimensions, Equipment Type, Etc. (i.e., Non-Timing Data)	Requirements For Non-Repetitive Timings	Requirements For Repetitive Timing Subelements	Needs For Data Reduction
Comparison: Crane-On-Deck vs. TCDF	Different position of crane relative to lift, resulting in:	Wave size and direction; lighter type; number of hatches on ship; size of hatches; number of containers per hatch; Number of parts in hoist line; kind of spreader; distances cranes move (when they relocate)	Timing of hatch cover movements, timing of crane movements, timing of barge movements	Lighter-cycle/crane-cycle overlap (dictates synchronized watches)	Mean times for full cycle. Standard deviation, means for each of the five basic data elements.
	1. Different distances cargo moves during lift	Ship freeboard; hold number; deck level in hold; ship beam; obstructions to travel of lift beam. Does lighter reposition during operation?			
	2. Different visibility of operation to operator of crane	Space available in lighter, or orientation of containers		Timing of approximate time lift disappears from view of operator of crane, and when it reappears (at lighter or hold of ship). Sample basis on both COD and TCDF.	For cases where crane operator must depend on signals, percent of the time in each basic element that crane operator works "blind"
	3. Pendulation difference	Estimated feet of pendulation swing	Time for activating powered taglines when used	If separable, activities of tagline handlers; times for handling, installation and moving of tagline each cycle.	

To these ends, the information should be available on a shift basis, with reports as of a to-be-specified cut-off time. These reports will consist of information as specified in the Data Collection Plan, Joint Plan of Test published by the JTD.

SPECIFYING QUANTITIES FOR REPETITIVE TESTS

Specifying the quantity of repetitions of test lifts is a judgmental decision. It is one that has been discussed in some detail in the LOTS Feasibility Study.[3] In the main, the judgment arrived at there (that throughputs of at least 600 container lifts for the crane-on-deck operations of the test and 600 more for the crane-on-barge operations) remain valid. Such a judgment is based partly on statistical reliability considerations, but the overriding need for the test program is to provide sufficient throughput to measure the system's capability for sustained effort. People and machines must be tasked in a way that includes test periods long enough to span initial learning improvement, fatigue effects, variations in the environment (e.g., wet and dry, night and day), and variations in physical circumstances (such as high or low tide, full or near-empty fuel tanks on certain lighters, and full or empty holds in the ships). Deciding what is a sufficient number of repetitions to accomplish the above outlined goals must be based largely on remembered experience and intuition, rather than scientifically valid data (for which there have been only fragmented opportunities to collect in the relatively new and rapidly-changing art of handling commercial containers in a LOTS environment). The decision must be considered as a balance, where a very large amount of throughput (for example, 10 ship loads) would be prohibitively and unnecessarily expensive, while small quantities (like 50 to 100 containers) would fail to support a sustained effort and would be statistically unreliable.

The statistical reliability of the tests has been discussed in detail in the LOTS Feasibility Study. The discussion here does not repeat the analysis set forth there of possible statistical uncertainties in the measured times nor the estimated impacts of consequent errors in planning factors derived from the measured times. However, enough of the discussion in that report is summarized below to permit showing how additional information and some proposed improvements in techniques can impact on the test findings. These extensions do not change the previous estimates of statistical uncertainty but do further discuss the potentials for increases and decreases in it. The matters discussed include: a) a revised assessment of the role of hatch cover removal and other "non-lift" time elements; b) the use and analysis of time data more detailed than had been addressed in the previous report; and c) use of techniques to reduce areas of statistical uncertainty.

The essence of the statistical accuracy of measurement discussed in the LOTS Feasibility Study is summarized in these statements (note some portions, as will be discussed further, have now been reassessed):

- Throughput rates for cranes, which usually control overall throughput rates, typically depend on times

[3] Operations Research, Inc., Feasibility and Definition of a Joint Logistics-Over-The-Shore (LOTS) Operational Test, ORI Technical Report No. 913, 30 April 1975.

for both: a) repetitive lifts and, b) non-lift elements. The accuracy of throughput planning factors would seem to depend more strongly on a) than b), since on the order of four-fifths of the time of crane operations is estimated to be spent on a) the repetitive lifts. Measurement uncertainities in b), the remaining one-fifth of the time contributed by such non-lifting activities as repositioning of cranes, adjustments to cargo gear, removing hatches, and the like[4], thus, have less weight and are likely to be less important to the final planning factor.

- The repetitive cycles are at once remarkably alike in that they consist of the same basic operations repeated time after time; yet the physical differences in reach and other factors from one cycle to another may be large. From the statistical viewpoint measurements of cycle times of the same operation in past tests have been so varied that substantial uncertainities in the final averages had to be accepted. (From the report on the OSDOC tests, for example, in discussing the differences among the rates for four cranes lifting the same cargo, the statement was made that "because of small sample size (i.e., smaller number of repetitions timed) differences of roughly 40 percent (between cranes) would have had to exist in order to be detected."

- The amount of uncertainty in the calculated average of a number of repetitive lift cycles decreases in inverse proportion to the square root of the number of lifts measured. For example, to decrease the uncertainty of a calculated mean to one-half its initial value, the number of lifts must be increased four times:

$$\frac{1}{\sqrt{4}} = \frac{1}{2}$$

For the OSDOC tests the number of cycles measured for each condition averaged about 11, and the potential variation of the resulting mean values, at a 95 percent confidence level, was $\pm$ 20 percent. To cut this potential in half (i.e., decrease it from 20 to 10 percent, again a 95 percent confidence level) the number of cycles would have had to be increased fourfold, or to 44 cycles from the initial 11 cycles.

---

[4] In this document the term "non-lift element" is used to distinguish actions that occur only once per several cargo lifts. These relatively seldom occuring activities may themselves be repetitive.

The preceeding facts and calculations are a quick summary of the material set forth in considerably more detail in the referenced LOTS Feasibility Study. To these now may be added the further considerations that have come forward since the other was written:

- A refinement has been made to the concept outlined above of the relative importance of non-lift time elements to the overall planning factors.
- Some additional experience was acquired from the pretests in taking and analyzing more detailed time data within the cycle.
- A technique for analyzing detailed data elements will be used to decrease statistical uncertainty of the time averages of certain repetitive cycles.

Contribution of Non-Lift Time to Uncertainty

The planning factor uncertainty, as discussed above, depends on both the non-lift elements and the repetitive elements of the total time required for moving cargo. Both elements vary from situation to situation. The non-lift times, as mentioned before, for ship operations constitute on the order of one-fifth of the total time. Contrary to the previous assessment, however, this small fraction of the total time may possibly contribute a more than proportional share to the statistical uncertainty of the planning factor. Every effort must be made to record all elapsed times for these non-lift operations, in order to keep the uncertainty in the results from this source as small as possible.

Pretest Experience with Detailed Time Segments

The pretests increased the experience with timing techniques although they did not add significantly to the data available for analysis of throughput variability. There were not enough repetitions of the same operations to warrant changes in the previously made assessments of statistical variability. The pretest timings included recording of detailed within-cycle times. At least one virtue of the detailed timing became apparent. Delays and interruptions would ordinarily have caused some overall data on full cycles to be thrown out. With the detailed timing procedure available timed parts of incomplete and interrupted cycles could, in effect, be recombined into new cycles for analysis. Thus, not so much data was unusable. Presumably, the use of the detailed timing in the main test will permit a greater fraction of the total data taken to be used (with consequent correspondingly small decreases in uncertainties).

Statistical Procedures

Various analytical and statistical techniques will be used in the analysis. Some will yield insights on the validity of certain comparisons. Others are expected to reduce statistical uncertainty somewhat by changing unexplained variability to explained variability, particularly within certain of the basic elements of the cargo transfer cycles discussed above. One of

the reasons for using the separate time elements rather than overall cycles is that the elements are more likely to be statistically relatable to physical measurements of the transfer cycle than the entire cycle would be. For example, it may be possible to relate time element D, move the load, to numerical values of a) the distance in feet the load is actually moved; and b) certain measures of how fast the crane or boom can vertically move the load (e.g., the number of parts in the hoisting line). If in fact such relationships can be established, a part of the variability of the cycle is changed from simply being an unexplained variation to being an explained one, with a consequent reduction in uncertainty.

SPECIAL TEST RUNS FOR WEATHER-EFFECTS DATA

As discussed in some detail in the ORI report on the results of the breakbulk test,[5] analysis aimed at assessing the effects of sea state on LOTS operations presents difficult problems. Among them two aspects are particularly vexing for the LOTS main test analysis:

a. All or most of the test will have to be conducted in whatever sea state happens to occur (rather than being a matter under experimental control) and

b. There is a lack of knowledge concerning the mechanisms through which sea state phenomena affect the operations. That is, there is as yet no theoretical-practical framework on which an analysis of sea state effects can readily be based.

The first aspect must be accepted with its attendant uncertainty. The second appears to be a long-term problem and requires documented observations over more tests than are likely to be made in the next few years, together with the on-going theoretical work on platform motion and crane operations that is being pursued in the Navy COTS program. One possible step toward limited control of weather effects mentioned as the first aspect above, would be to move the site of vessel operations in response to weather. That is, if the sea state is high, record sample runs in the rough sea, then at a location in more protected water, make sample runs there. If the sea is calm throughout the test, near its conclusion consider moving off-shore for sample runs (provided forecasts show suitable sea states off-shore).

Such a procedure may or may not prove necessary. Over the period of a 3-week test there is a substantial probability of weather changes either toward higher or lower sea states occurring so that the desired result might well be achieved without moving.

---

[5] Operations Research, Inc., Report on Results of the Conventional Breakbulk Ship Pretest of the Joint Logistics-Over-The-Shore (LOTS) Test and Evaluation Program, ORI Technical Report No. 1037, 29 October 1976.

APPENDIX A
SERVICE TEST OBJECTIVES

GENERAL

Following publication of the LOTS Test Feasibility and Definition Study and early in the organization of the LOTS Joint Test Directorate (JTD), each of the participating Services presented a list of objectives which were then consolidated by the Joint Test Directorate. The objectives represented particular areas of interest the Services desired accomplished during the conduct of the pretests and main test. In some cases these objectives required particular efforts by the sponsoring Service that were in addition to the other activities to be performed in support of the LOTS test program. In some cases the objectives coincided with DDR&E objectives while in other cases they were strictly experimental and not within DDR&E guidelines for support of the test. In the latter case, especially, it must be understood that any experimentation outside the bounds of this test must be conducted on a not-to-interfere basis.

Service in-depth analysis of test results in the light of Service objectives included in the LOTS test will be possible from the data collected and objectively reported by the JTD. Service-peculiar tests relating to mission changes in doctrine, R&D equipment, and other special trials may be separately accomplished during the LOTS main test so long as they do not detract from or degrade the capabilities of participating organizations.

It must be reemphasized that this is an operational— not a developmental— test. With respect to the Service test objectives contained in Table A.1, the Services may conduct as many pre-main test equipment and procedural check-outs as they desire and are encouraged to do so. In the main test LOTS units will deploy and operate with authorized equipment on-hand using latest accepted and approved Service doctrine and procedures with a sense of urgency appropriate to an actual emergency situation.

TABLE A.1

SERVICE TEST OBJECTIVES AND COMMENTS

Service Objectives For The Joint LOTS Operational Test	Comments
1. Assess the requisite planning for embarkation of AFOE and LOTS supplies, equipment and personnel in containerships and bargeships as well as breakbulk merchant ships. (Pretest/Main Test)	
1.1. Plan for acquisition of container (including refrigerated containers if required) and barge services at the locations where they would in reality have to be stuffed/loaded with materials. (Pretest/Main Test)	
1.2. Plan for accomplishment of container stuffing and barge loading operations. (Pretest/Main Test)	
1.3. Plan for movement of personnel, breakbulk cargo, containers and barges to the POE(s). (Pretest/Main Test)	
1.4. Plan for embarkation operation at the POE(s). (Pretest/Main Test)	
1.5. Determine requirements for equipment and procedures to provide an acceptable level of habitability for personnel embarked in AFOE or LOTS merchant shipping. (Pretest/Main Test)	
2. Assess the Services deployment capability of AFOE and LOTS equipment and procedures for introducing personnel and supporting equipment into an objective area. (Pretest/Main Test)	
2.1. Evaluate the deployment and off-loading of Army craft, materials handling equipment (MHE), and containers in a LOTS environment. (Pretest/Main Test)	
2.1.1. Determine realistic equipment preparation times. (Pretest/Main Test)	
2.1.2. Determine realistic equipment loading and off-loading times. (Pretest/Main Test)	
2.1.3. Determine equipment set-up time after off-loading. (Pretest/Main Test)	
2.2. Evaluate the deployment and off-loading of container over-the-shore (COTS)/amphibious logistics system (ALS) equipment in an AFOE environment. (Pretest/Main Test)	
2.2.1. Determine realistic equipment preparation times. (Pretest/Main Test)	
2.2.2. Determine realistic equipment loading and off-loading times. (Pretest/Main Test)	
2.2.3. Determine equipment set-up time after off-loading. (Pretest/Main Test)	
3. Assess the capability of the shipside subsystems to off-load and retrograde containers and discharge breakbulk cargo.	
3.1. Evaluate the sustained productivity and operation of a mobile crane-on-deck (COD) ship unloading subsystem, including engineering performance of deck strengthening and hatch cover bridging as well as crane fatigue performance. (Main Test)	

TABLE A.1 (Cont.)

Service Objectives For The Joint LOTS Operational Test	Comments
3.2. Evaluate the sustained productivity and operation of a temporary container discharge facility (TCDF); to include warping operations and hatch cover operations. (Main Test)	
3.3. Evaluate the effects of sustained operations for five or more consecutive days on COD and TCDF productivity and engineering performance of components. (Main Test)	
3.4. Evaluate the productivity and operational effects of devices to reduce container impact on lighterage for both the COD and TCDF modes. (Main Test/Limited Pretest)	3.4. Standard dunnaging will be used as opposed to intermittant testing of special devices.
3.5. Evaluate the effects of a power tagline on COD and TCDF productivity. (Main Test/Limited Pretest)	3.5. Power taglines on COD-TCDF cranes will be evaluated on basis of normal operational use.
3.6. Evaluate the comparative productivity and manpower demands of COD and TCDF cranes using slings versus spreader bars for container movement. (Pretest)	
3.7. Evaluate the effects of environment, forces, and motions on COD and TCDF productivity. Obtain quantitative data through instrumentation. (Main Test/Limited Pretest)	
3.8. Exercise and evaluate bulk fuel ship-to-shore transfer capability in conjunction with a LOTS operation. (Main Test)	
4. Assess the capability of various craft subsystems to move containers and breakbulk cargo ashore and to retrograde containers.	
4.1. Evaluate the capability and productivity of ferrying containers to shore via causeway barge-ferry, employing either the lift-on/drive-off or the lift-on/lift-off concept. (Main Test/Limited Pretest)	
4.2. Evaluate LASH barge discharge rates that can be sustained under sea conditions expected to be encountered in an AFOE or LOTS environment. (Pretest/Main Test)	
4.3. Evaluate procedures and practicability of initiating and terminating various modes of transfer operations for container and palletized cargo. (Main Test)	
4.4. Evaluate the sustained productivity of the LACV-30. (Main Test/Limited Pretest)	
4.5. Evaluate the sustained productivity and capability of the LCM. (Main Test)	
4.6. Evaluate the sustained productivity and capability of the LCU. (Main Test)	
4.7. Evaluate the sustained productivity and capability of the LARC-60. (Main Test)	
5. Assess the capability of shoreside subsystems to discharge lighterage.	
5.1. Evaluate the capability of Army container handling in terminal operations (CHITO) equipment to operate in a nonfixed port environment. (Main Test)	

TABLE A.1 (Cont.)

Service Objectives For The Joint LOTS Operational Test	Comments
5.2. (Marine) Evaluate fleet marine force (FMF) capability to remove containers from lighterage without benefit of a crane operated on an elevated causeway. (Main Test)	
5.3. Evaluate the sustained productivity and operation of an elevated causeway shoreside discharge facility. (Main Test)	
6. Assess the capability of shore transport equipment and shoreside beach improvements required to handle containers and breakbulk cargo.	
6.1. Evaluate the capability of the 34-ton trailer. (Main Test)	
6.2. Evaluate the capability of the hydraulic fifth wheel yard tractor. (Main Test)	
6.3. Evaluate the capability of the 22½-ton breakbulk/container transporter. (Pretest/Main Test)	
6.4. Evaluate beach surfacing methods and techniques. (Main Test/Limited Pretest)	
6.5. Evaluate the time required for shoreside improvements necessary to allow container operations. (Main Test)	
6.6. Evaluate the operational effectiveness of lighting, auxiliary power, and communications equipment employed in the LOTS operation. (Pretest/Main Test)	
6.7. (Marine) Evaluate selected items of commercial container handling equipment which may be suitable (without major modification) for use in a logistics support area (LSA) environment. (Main Test)	6.7. The general comment "...selected items of commercial...equipment..." is so general as to permit the introduction of a number of candidate items for comparison for future selection and procurement. Only those items will be permitted which have at least been tentatively selected for procurement and will be used throughout the exercise for evaluation purposes.
6.8. Evaluate FMF equipment (programmed as well as existing) capable of handling/transporting 20-foot containers ashore. (Main Test)	
7. Evaluate operational equipment and procedures for ship anchoring, fendering, and ship handling during container discharge operations. (Pretest/Main Test)	
8. Test and evaluate tethered balloon discharge concepts in LOTS operation. (Pretest)	8. Not applicable.
9. Assess container breakbulk cargo management concepts and procedures.	
9.1. Evaluate container accountability procedures. (Pretest/Main Test)	
9.2. Evaluate effectiveness of the container/chassis remote scanner. (Pretest/Main Test)	9.2. Continued service testing of this device must not interfere with the test and evaluation of the units current documentation and cargo management systems.
9.3. Evaluate the total system concept for cargo documentation procedures, including the use of automated equipment, from (exercise) shipper to (exercise) consignee. (LSA and OSSA) (Main Test/Limited Pretest)	

TABLE A.1 (Cont.)

Service Objectives For The Joint LOTS Operational Test	Comments
9.4. Evaluate the capability to exercise control over cargo movement from ship to logistics support area to permit the expeditious identification and location of both containers and breakbulk cargo. (Main Test/Limited Pretest)	
10. Evaluate operating procedures for support of Service land forces from container and barge ships in an AFOE/LOTS environment.	
10.1. Evaluate the Service organizations' capability to discharge, transfer, and handle cargo on the beach. (Main Test/Limited Pretest)	
10.2. Evaluate the Service organizations' capability to construct facilities and prepare beaches for AFOE/LOTS operations. (Main Test/Limited Pretest)	
11. Assess the Services capabilities to provide command and control for AFOE/LOTS operations.	
11.1. Evaluate Navy command and control procedures involved in AFOE operations. (Pretest/Main Test)	
11.2. Evaluate the ability of the Services to transition from a Marine/Navy AFOE beach to an Army LOTS operation. (Main Test)	
11.3. Evaluate the capability of the Army terminal battalion headquarters to manage and control the deployment/discharge operation. (Pretest/Main Test)	

APPENDIX B

SCENARIOS

NON-MOBILIZATION AND MOBILIZATION SCENARIOS[1]

A U.S. alliance is being threatened by a politically unstable situation in which Crystal, a friendly, underdeveloped coastal nation is being threatened by its neighbor, Mountain. Radical Mountain leaders hope to use a wartime military emergency to consolidate their political gains in the Mountain government and expand their financial resources and power base through the acquisition of Crystal. Crystal has requested military assistance and its economic, strategic, and political interests are considered vital to the U.S. The President of the U.S. with the support of Congress has alerted the Joint Chiefs of Staff to prepare a task force for assistance to Crystal and to deter Mountain from invasion. Reliable intelligence estimates have indicated that a strong U.S. presence in Crystal for approximately 6 months would discourage hostilities and greatly assist the military forces of Crystal in halting the infiltration of saboteurs. Congress has stipulated that total withdrawal must be completed by that time.

JCS establishes a joint command (see Figure B.1) and forces are nominated for support of the operation. The Army has been tasked with the responsibility of providing terminal service operations for breakbulk and containerized cargo. The Navy has been tasked with providing sufficient Military Sealift Command (MSC) breakbulk shipping of a conventional and heavy-lift nature to support the deployment of the seatail and the Air Force has been tasked with providing limited aircraft assets for movement of the advance party and necessary units to conduct early engineering and beach preparations.

---

[1] Scenarios for evaluation of force structure and equipment requirements will be published in a separate, classified, annex.

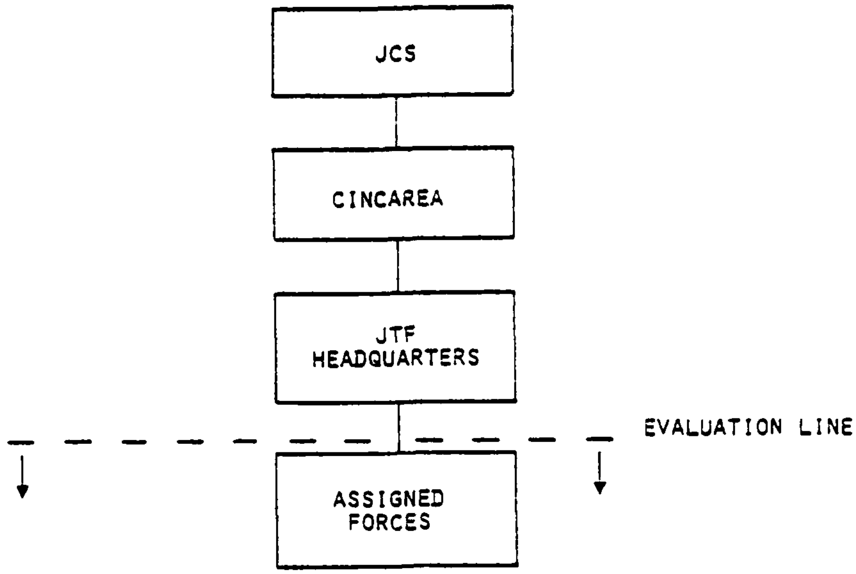


FIGURE B.1. JOINT COMMAND STRUCTURE

Major General Alton G. Post, Commanding General U.S. Army Transportation Center, as Joint Test Director will serve as CINCAREA and designate the JTF Commander. The JTF Commander will organize the JTF staff with personnel provided by the Services. For operations in Crystal the JTF comes under operational control of CINCAREA upon arrival. CINCAREA will provide support as necessary.

The non-mobilization situation involves quick-reaction forces deployed in response to a request for assistance to this underdeveloped country. Although the friendly government is threatened by an aggressive neighboring country, deploying airborne and seaborne forces from the U.S. will arrive unopposed. Mountain air and sea forces do not pose a significant threat to the subsequent LOTS operations.

The host nation has only a minor seaport with inadequate wharfage and insufficient water depth alongside to accommodate ocean going vessels. The existing port facilities are already overtaxed with coastal and inland waterway craft handling badly needed cargo to support the local economy and Crystal military forces. U.S. forces initially will be dependent on an air line of communications until a surface supply line is established employing Logistics-Over-The-Shore (LOTS) operations.

In view of the short lead time between the receipt of a request for assistance and the U.S. decision to respond, ocean shipping available for deployment of LOTS units to meet required on-berth dates is limited to assets of the Military Sealift Command augmented by a few tramp breakbulk and opportune specialized vessels. For the purposes of this exercise a heavy-lift breakbulk vessel, a containership, and a SEABEE bargeship will be used for deploying selected elements of the LOTS force along with delivering breakbulk and containerized resupply cargo.

The Joint LOTS main test plan commences with the alert of participating units and the assembly of a Joint Task Force command element at Ft. Eustis, Virginia. Units are brought to a high state of readiness and prepare to deploy to aerial and sea POEs on order.

Seventy-two hours after receipt of the warning order (D-3), orders are received to execute the operation plan (D-Day). Advance parties of the JTF headquarters and major operating units depart by air for the objective area on D+4 and D+5. (Movement by air will be simulated. Advance parties will move by highway to Ft. Story, perform site selection, and begin establishment of an operating base.)

Ten days later (D+15) the main party begins to deploy by air with minimum essential equipment to prepare the beach sites, routes to and from an assembly area, etc. (Although all such equipment will be moved by surface means, each item will be documented indicating full nomenclature, and dimensions and how deployed; e.g., tractor, FTRAC, D7 with dozer blades, 168 in. x 83 in. x 61 in., 36,805 lb, 492.2 cu, deployed by C141 or C5.)

Five days after receipt of movement orders (D+7), the simulated JTF seatail echelons depart for loading at waterports of embarkation. Selected LOTS outsize, heavy equipment will be loaded on a heavy-lift breakbulk ship. The balance of the unit TOE and accompanying supplies will move by surface means to the operating area. Again, all major equipment items will be documented. Data must be obtained for later evaluation to determine the amount of shipping that is required to deploy these units.

The advance parties, main bodies—both air and seatail—must deploy early enough during the exercise to ensure that the beach is fully operational before the non-self-sustaining ship is standing off-shore. Backward planning from that date is required to determine the start of beach preparation and the latest date the heavy-lift breakbulk ship is to commence out-loading operations at NSC.

An illustrative main test schedule for the non-mobilization scenario is contained in Figure B.2.

POL will be provided by tanker trucks. Ship-to-shore bulk POL resupply operations will not be played.

MOBILIZATION SCENARIO

General Situation

Following World War II the expansionist policies of Orange threatened the takeover of the neighboring democratic government of Blueland, gravely weakened by the war. In response to requests for assistance, the U.S. provided massive aid for the economic recovery of Blueland. Military assistance was also provided to counter the threat of a revolt instigated by Orange sympathizers.

TEST DAYS	SCENARIO DAYS	
T-Day	D-3	Warning order issued
	D-2	
	D-1	
T-1	D-Day	Execution of OP Plan Ordered
	D+1	
T+2	D+2	(Movement Order Issued–Simulated)
	D+3	
T+3	D+4	Advance Party Deploys Initial Element
T+4	D+5	Advance Party Completes Deployment
	D+6	
	D+7	(Simulated loading begins Heavy-Lift Breakbulk Ship)
	D+8	(Simulated loading continued Heavy-Lift Breakbulk Ship)
	D+9	(Simulated loading completed Heavy-Lift Breakbulk Ship)
	D+10	
	D+11	
	D+12	(Simulated Seatail Echelon Sails - see events of D+23)
	D+13	(Simulated Seatail Echelon Sails)

TEST DAYS	SCENARIO DAYS	
	D+14	
T+5	D+15	(Troop Deployment (AIR) Commences–1st Echelon) Main Body Commences Deployment
	D+16	(Troop Deployment 2nd Echelon)
	D+17	(Troop Deployment 3rd Echelon)
	D+18	(Troop Deployment 4th Echelon)
	D+19	(Troop Deployment 5th Echelon)
	D+20	(Troop Deployment 6th Echelon)
T+6		Heavy-Lift Breakbulk Ship Loads Exercise Cargo, Troop Deployment Completed
T+7		Heavy-Lift Breakbulk Ship Loads LOTS Equipment; Sails
T+8	D+23	Heavy-Lift Breakbulk Ship Arrives, Commences Unloading
T+9	D+24	Off-Load LOTS Equipment Continued
T+10	D+25	Off-Load of LOTS Equipment Completed
T+12	D+27	Beach and Site Preparations Completed
T+13	D+28	Containership Arrives and Off-loads Deployment Cargo, 150 Containers; Breakbulk Ship Discharges 150 S/T Cargo, 75 Drums
T+14	D+29	Bare Beach Operations Continued
T+15	D+30	Bare Beach Operations Continued
T+16	D+31	Bare Beach Operations Continued
T+17	D+32	Bare Beach Operations Completed

FIGURE B.2. NON-MOBILIZATION SCENARIO SCHEDULE FOR THE LOTS TEST
(Simulated Events Contained in Parentheses.)

An outgrowth of negotiations between the U.S. and Blueland was a mutual assistance treaty in which the U.S. pledged to come to the immediate aid of Blueland in the event of an attack by any other nation(s). The treaty was subsequently ratified by the Senate. Since that time the Blueland economy has enjoyed a rapid recovery and the country has become a close trading partner with the Western World. Imports of certain ores and bulk petroleum from Blueland are particularly important to the U.S.

Until the U.S. intervention in the Crystal-Mountain crisis, the U.S. and Orange have successfully negotiated agreements concerning sporadic Orange-Blueland border incidents. Following that intervention, however, tensions between the U.S. and Orange have mounted sharply.

While the U.S. continued to press for a peaceful settlement of the dispute, Orange recalled its Ambassador from Washington, and began mobilizing its military forces. Blueland called up its Reserves and manned defensive positions along the Orange border.

In view of the failure of diplomatic approaches for tasks with Orange leaders and intelligence reports that Orange may attack at any moment, the President of the U.S. placed U.S. military forces on alert. A request for Congressional approval for the call up of selected National Guard and Reserve units was also being staffed.

At 0500 hours, D-Day, Orange forces launched an attack on Blueland along a broad front. The attack occurred while the last of the deploying units closed in Crystal. Blueland border units were able to slow and contain the attack except near Blue Haven. There, enemy artillery heavily damaged port facilities eliminating their use for at least 3 months.

In response to a request for assistance and the possibility of outbreak of hostilities in other areas of the world, the U.S. began to mobilize its forces and to dispatch troops to Blueland. U.S. Navy and Marine Corps units were alerted for movement to Blue Haven as soon as possible and to secure a beach head, if necessary, by amphibious assault. In Crystal where the port congestion problem was brought under control, U.S. Army LOTS units were alerted for redeployment to Blueland.[2]

The military situation in the south sector of Blueland continued to worsen (see situation map, Figure B.3) and on D+40 the U.S. Navy with embarked MAF launched an amphibious assault over Green and adjacent Red and Blue Beaches. Enemy advance units were caught by surprise and driven back to the White River. The Marines off-loaded their assault echelon equipment and supplies. During this period Navy units erected an elevated causeway.

---

[2] In this scenario due to the emergency powers of the President, ship availability will not be a limiting factor for test purposes. Total ship requirements will be determined in the evaluation following completion of the test.

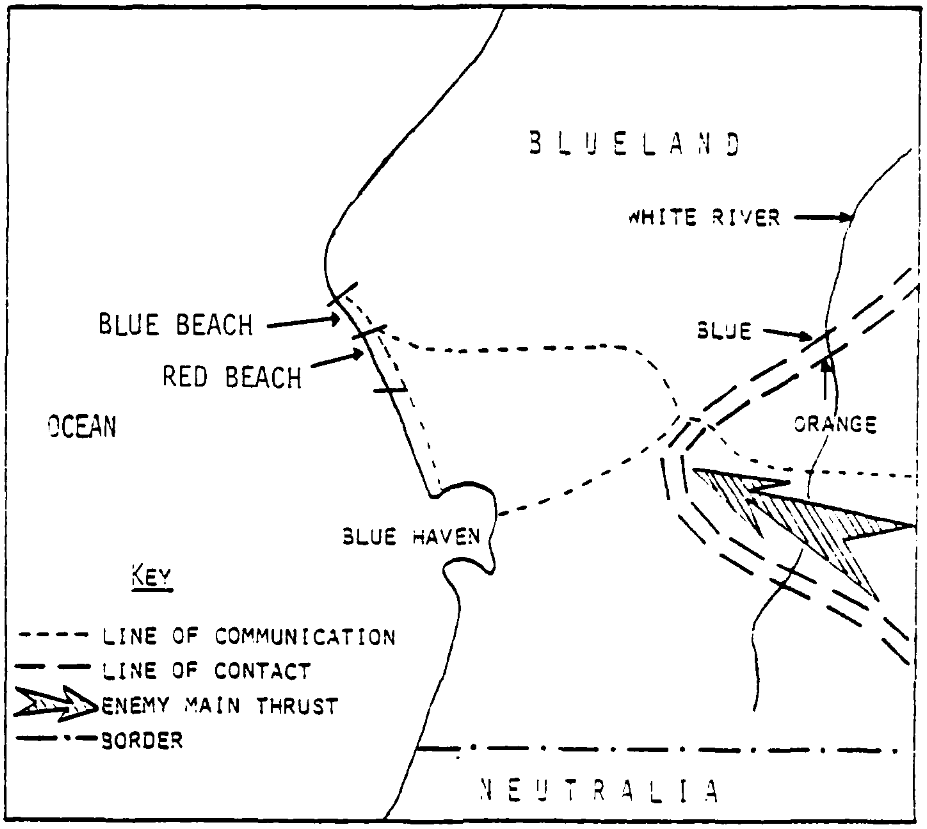


FIGURE B.3. SITUATION MAP ON D+40

Improved Beach Operations

By D+50 the military situation in the south sector has improved and the enemy threat to the beach area operations is minimal. The Navy/USMC beach operation, augmented by arriving U.S. Army lighterage units, is handling all general cargos over Red/Blue Beach.

As major U.S. Army combat elements being to arrive, it becomes apparent that the LOTS capability at Red/Blue Beach must be expanded. Also, with a planned shift in support to a predominantly Army combat force, CINCUS-WEST has requested the U.S. Army augment the USN/USMC over-the-shore operation and be prepared to assume responsibility for the joint LOTS operation by D+63. Army elements are attached to the JTF with advance parties arriving on D+51. (The Chain of Command is depicted in Figure B.4.)

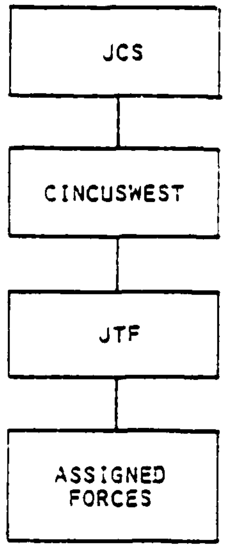


FIGURE B.4. CHAIN OF COMMAND

On D+62 the USN/USMC throughput and retrograde operations are completed and the transition is made to an Army managed joint LOTS operation consisting of both Army and Navy support units. With regard to the improved beach cargo handling facilities, the JTF commander has requested retention of all Service assets for use during the duration of the joint LOTS mission. (During this final phase of joint LOTS test operations, attempts will be made to determine the maximum throughput rate of the improved beach shore container handling subsystems. To tax the throughput capability of both the elevated causeway and the DeLong pier will require the employment of a third crane at the containership.)

With vessels of all types being used to meet U.S. movement requirements, the LOTS commander is confronted with the requirement of handling barge delivered cargo (pallets, vehicles, containers) concurrently with containers from containerships. Both the Navy and Army systems are having to accommodate to these diverse ship delivery systems.

As a support element of the JTF, a communications unit is available for handling logistic data requirements including MILSTAMP traffic. A DASPS mobile van is provided with a communications link to the computer at the logistics base established in Blue Haven by elements of the 1st Support Command. (These elements have been providing cargo documentation and movement control support throughout the exercise.)

APPENDIX C
SHORESIDE CARGO TRANSFER PROBLEMS, BARE BEACH

This appendix provides a partly quantitative review of the physical problems encountered during cargo transfer operations from lighters at the water's edge. The problems are those expected to be encountered at the LOTS test site at Ft. Story, Virginia, but comments are also made concerning the problems at beaches in general. Given time and material to construct facilities and clear channels, the problems discussed can be alleviated. This appendix discusses the problems that are faced in a "bare beach" operation during a period before major improvements can be installed, such as piers elevated above the surf. The appendix includes a brief discussion of the crane platforms currently available that could be considered for the period of bare beach operations.

The primary problem is that cargo transfer from landing craft at the water's edge is hindered by water depth. The problem is made worse by tide changes and waves, yet the transfer must take place close to shore. Amphibian lighters permit the transfer to be made ashore out of reach of surf, but current amphibians are generally unsatisfactory from the point of view of availability and have limited cargo/container capacity. Causeway ferries provide an appropriate capability but have freeboard limitations and, like amphibians, are in short supply.

There appears to be no fully satisfactory solution to the problems outlined in this appendix. All available alternatives appear to be time-consuming during the phase of LOTS operations when urgency is important. Additionally, most require considerable strengthening, some modification, and present deployment and assembly problems.

DISTANCE BETWEEN THE WATER'S EDGE AND THE LANDING CRAFT

Landing craft "ground out" in approximately 4 ft of water when at full load displacement and in somewhat less water when loaded with containers.[1] The calculations shown hereafter arbitrarily assume that operationally the landing craft of concern (LCUs and LCM8s) can operate in 3½ ft. If the near-shore underwater profile of the beach is steep, the landing craft can come in close to shore, even with a 3½-ft draft. Containers or other cargo can be lifted off using a crane operating from dry land with a reasonably short reach. At a steep beach vehicle cargo can be driven off the landing craft ramp dry or without having the vehicle wade in unduly deep water. Unfortunately, beaches steep enough to do these things appear to be an exception rather than the rule.

One way of quantifying beach steepness or flatness is in terms of an average slope to seaward of the low-water mark. Actual beaches have slopes that vary somewhat from their own average and usually include sandbars. However, the concept of an average slope within the limited zone between the low water mark and a depth of about 4 ft has proven useful. For instance, an average slope of 2 percent is typical of Ft. Story. For such a slope the water depth increases 2 ft for every 100 ft moved out from the low water mark. Note that the slope is steeper on the beach exposed between high and low water. Thus, a 3½ ft depth occurs 175 ft from the water's edge. It is not feasible for a crane to reach that far out from shore. Most beaches are even flatter. As indicated in Section II, page 33 of this study on site selection, 81 percent of beaches in various strategically important areas of the world had slopes less than a ratio of 1 to 61 or 1.64 percent.

The impact of a flat beach slope on the horizontal distances involved is worsened by tidal changes and waves. The mean tide difference at Ft. Story is 3.2 ft. The corresponding horizontal distance in the steep part of the beach between high and low water averages approximately 50 ft at Ft. Story, according to the available surveys. This means that the total horizontal distance from the high water mark to the place where the depth is 3½ ft at low water is 175 ft plus 50 ft, or 225 ft. This is an approximate minimum figure for round-the-clock operations at the parts of Ft. Story beach where the slope is 2 percent. For planning purposes the data may be used as follows. On available surveys of the beach sketch in a contour for 3½-ft depth.

---

[1] It would be desirable to have available formally collected and documented data on the operational depth for grounded landing craft, taking into account the effects of different displacements, the slope of the bottom, the assistance of surf in riding further toward shore. Such data are not available, to the knowledge of the authors.

Scale off its distance from the high water mark. The distance averages 210 ft and varies between 150 ft and 300 ft. The resulting figure could be used when considering the combined reach of a crane and any pier or platform extending out from the high water mark.

This minimum does not yet include an allowance for the distance within the craft between the cargo location and the point where the craft grounds out. The grounding point is usually 10 to 20 ft aft of the bow, but the distance depends on the location and size of the load. It also depends on the underwater slope and even on the wave height, since landing craft can sometimes make use of the temporary buoyance from swells to move in somewhat closer. No attempt is made here to take these diverse matters into exact numerical account, but an allowance for reaching the load in the lighter above the minimum must be considered. For LCM8 operations the allowance ought to be in the neighborhood of 25 ft and for LCUs around 75 ft. For the 2 percent beach slope example a round figure would be to increase the minimum "reach" of whatever platform and crane combination is being contemplated to 250 or 300 ft from the high water mark.

EFFECTS OF SURF

Surf action is one of the most important considerations affecting the beach transfer of cargo. One solution to the need for increasing a crane's reach involves positioning a platform/barge at or near the water's edge. The crane could then be positioned further seaward for unloading landing craft.

In an operation in surf, a crane platform would be subject to wave forces that tend to move it. Breaking waves can impact on structures with very sizable dynamic forces. For grounded landing craft there is a tendency to turn (i.e., broach), and any platform considered would presumably have similar tendencies. To resist these forces requires some provision for anchoring to the bottom, securing with pilings and/or lines to the shore. Anchors and guys to shore are least satisfactory because of the looseness of a sand beach.

In the surf zone along beaches there is a transport of sand that also must be considered. It comes about from the angle the waves make with the beach. As can be seen in resort areas where groins are set up to slow or change this transport, the up-current side of an obstruction impounds sand against a dam. There is a loss of sand ("starvation") on the downstream side and possibly under the structure. The net effect is a possible unsymmetrical buildup of sand over a period of time. The sand foundation may cut away from under the downstream side causing the platform to tilt. This change in the sand is a potential threat to the operational use of a platform that is grounded in the surf The threat is difficult to evaluate, partly because it depends on the wave size encountered in the operating period. The time needed for a serious change of sand foundation depends not only on wave size and direction, but also on the local tidal current. Informal estimates made at the Corps of Engineers Coastal Engineering Research Center at Ft. Belvoir are that waves about 2½ ft high would begin to affect the operation of a grounded barge in the surf in as little time as one day.

APPENDIX D

INTERIM RESULTS OF LOGISTICS-OVER-THE-SHORE SIMULATIONS

INTRODUCTION

This appendix presents the results of the Logistics-Over-The-Shore (LOTS) simulation model. The purpose of the model runs discussed is to validate and refine test concepts, resource requirements, timings, and operational procedures for the Joint LOTS Operational Test.

A series of computer runs was made to provide a sensitivity analysis of the bare beach operations and of the improved beach phases of the main test. Parameters, such as the lighterage mix and speeds, distance of the containership from the shore, etc., were varied. The planning factor for container throughput is 300 containers for a 20-hr operational day. The simulation model was used to compute the time to discharge 300 containers from the ship.

In using the model for the analyses, the total time for unloading the cargo and moving it ashore to a marshalling area was the principal model output. It should be noted, though, that the minimum time for unloading when the system is in balance is, in fact, the direct result of the input selection. That is, when the ship unloading rate is specified, the minimum time for moving the cargo ashore is the time for all the cargo to move out of the ship plus the time it takes the last piece of cargo to move from the ship to the marshalling area. If there is any time spent waiting for lighters the total time increases. Thus, in the runs to be discussed, the model was usually used starting with too few assets, which resulted in a greater than minimum time. Then in each succeeding run the assets were agumented until the predictable minimum time was achieved. Any further increase in assets, of course, could not reduce the minimum time. Note also that the model is an "expected value model" that does not take into account the variability of rates.

Performance characteristics of LOTS system equipment are input to the model. Table D.1 shows the data used for lighter speeds, capacities, and for mooring and unmooring times. The assumed container transfer times at the ship (where two cranes were modeled), at the shore, and at the marshalling area are in Table D.2.

TABLE D.1

LIGHTER CHARACTERISTICS

Lighter	Nominal Speed (knots)		Container Capacity	Mooring Time (min)	Unmooring Time (min)
	Empty	Loaded			
Causeway Ferry	5	3	12[1]	5	2
LACV-30	50[2]	42[2]	2[3]	1	1
LARC-XV	5[4]	4[4]	1[5]	2	2
LARC-LX	6.6[4]	6.2[4]	1	2	2
LCM8	11	9	1	2	2
LCU	8	6.5	4	5	2

[1] Four section causeway ferry.
[2] The speed of the LACV-30 on land is taken as 30 mph.
[3] The LACV-30 can carry two containers not to exceed 30 short tons with 2 hr of fuel.
[4] The speed of the LARC-LX on land is taken as 15 mph when empty and 14 mph when loaded.
[5] The LARC-LX carries one container not exceeding 15 S/Tons.

TABLE D.2

CONTAINER TRANSFER TIME

Location	Cycle Time (min)
Ship	
COD	5
TCDF	5
Shoreside	
Crane-on-Beach	5
Crane Inland (used for amphibians)	3.5
Elevated Causeway	4
DeLong	4
LACH	10
Marshalling Area	3

BARE BEACH OPERATIONS

For the bare beach phase, two LOTS crane elements were modeled for the unloading of containers from lighters: the crane-on-beach for unloading landing craft and an inland crane for unloading amphibians. Both cranes were assumed to operate full time. The lighters available for this phase of the test are two LACV-30s, four LARC-LXs, and at least nineteen LCM8s. One LACV-30 and three LARC-LXs are assumed to be available for a full day of container operations, leaving one of each available as a backup. A separate set of runs was made substituting LCUs for LCM8s.

A series of computer runs were made to determine the number of lighters and the time required to discharge the 300 containers from the ship in the bare beach operation. The lighter mix consisted of amphibians and landing craft. Since the number of amphibians is limited, they were held constant at one LACV-30 and three LARC-LXs. At 1 nmi the number of LCM8s was varied and the time to discharge the ship was computed. The results of these runs are shown at the top of Table D.3. The results show that a minimum time of 17.5 hr was reached when the number of LCM8s was increased to six; adding more LCM8s could not decrease this time. The LOTS system in this case was in near equilibrium with four amphibians being discharged at the inland crane and six landing craft at the crane on the beach.

TABLE D.3

TIME TO DISCHARGE 300 CONTAINERS IN THE BARE BEACH OPERATION USING LCM8s IN THE LIGHTER MIX

Lighters			Distance of Ship Off-Shore (nmi)	Lighter Speed	Time to Discharge 300 Containers (hr)
LACV-30	LARC-LX	LCM8			
1	3	4	1	Nominal	18.9
1	3	6	1	Nominal	17.5
1	3	7	1	Nominal	17.5
1	3	12	3.3	Nominal	19.9
1	3	16	3.3	Nominal	19.4
1	3	17	3.3	Nominal	19.4
1	3	12	3.3	Reduced	21.2
1	3	16	3.3	Reduced	20.2

Another series of runs was made to estimate the effect of increasing ship-to-shore distance to 3.3 nmi. The results of these runs are shown in Table D.3 The minimum time to discharge the ship was 19.4 hr which was reached when the number of LCM8s had been increased to 6; the total time increased to 19.9 hr when 12 LCM8s were tried. In general, increasing the distance from 1 nmi to 3.3 nmi increased the minimum time to discharge the ship from 17.5 to 19.4 hr, about 2 hr. The number of LCM8s had to be increased significantly— from 4 to 16— in order to keep the cranes on ship busy. In this case, the system was getting out of balance as the proportion of containers moving to the two shoreside cranes was changing. The minimum of about 17½ hr cannot be achieved because the number of amphibians is fixed.

Additional runs were made to determine the effects of changes in lighter speeds on lighterage requirements. Slightly reduced lighter speeds may occur in the main test because of winds and currents and operating conditions may limit the speed of amphibians. The assumed speed of the LCM8 was reduced 2 knots. The sea speeds of the amphibians remained the same but the land speeds were decreased. The speed on land of the LACV-30 was reduced to 15 mph and the LARC-LX to 10 mph. At 1 nmi the computer time to discharge 300 containers was 21.2 hr as compared to 19.9 hr for lighters operating at their normal speed. In general, the total time to discharge and move 300 containers through the system was not very sensitive to the above reductions in lighter speeds and, therefore, did not required an adjustment in lighter resources.

Next a set of runs was made using LCUs in place of LCM8s in the lighter mix. At 1 nmi off-shore a minimum time of 18.3 hr to discharge the ship was computed when four LCUs were used in place of six LCM8s. Again, to find the effect of increasing the ship-to-shore distance, the ship was simulated as being 3.3 nmi off-shore. A minimum time of 19.9 hr was achieved when the number of LCUs was increased to eight. The time to discharge the ship with a given number of LCUs is presented in Table D.4. Again, increasing the ship-to-shore distance required an increased number of lighters. The total time to complete the discharge of the 300 containers did not significantly increase.

TABLE D.4

TIME TO DISCHARGE 300 CONTAINERS IN THE BARE BEACH OPERATION USING LCUs IN THE LIGHTER MIX

Lighters			Distance of Ship Off-Shore (nmi)	Time to Discharge 300 Containers (hr)
LACV-30	LARC-LX	LCU		
1	3	0	1	33.3
1	3	2	1	21.3
1	3	4	1	18.3
1	3	6	1	18.3
1	3	2	3.3	29.5
1	3	4	3.3	22.3
1	3	6	3.3	20.4
1	3	8	3.3	19.9
1	3	10	3.3	19.9

An analysis was made of the last run with four LCUs and the ship 1 nmi off-shore to illustrate the computer number of lighter cycles in a 20-hr operational day. A lighter cycle is considered to be a roundtrip from the ship to the shore. The number of cycles for the LACV-30, the LARC-LXs, and the LCUs are shown in Table D.5. The assumed number of containers carried by each is given in Table D.1. Some partially loaded lighters, however, are anticipated. For example, lighters depart the ship when a hatch is empty even if they are not completely loaded. If two containers exceed the weight capacity of the LACV-30, it would travel to the beach with only one container. Both of these events occurred in the above computer run. This is why the expected number of containers (314) as shown in Table D.5. carried by the lighters exceed the actual number of containers (300).

TABLE D.5

NUMBER OF LIGHTER CYCLES

Lighter	Number of Cycles For Each Lighter	Expected Number of Containers Moved by Each Lighter
LACV	33	66
LARC-LX	20	20
LARC-LX	20	20
LARC-LX	20	20
LCU	12	48
LCU	12	48
LCU	12	48
LCU	11	44
TOTAL		314

A special set of computer runs was made using all amphibians in the lighter mix. The amphibians used were the LACV-30, the LARC-LX and the LARC-XV. The LARC-XV carried only one 20-ft container not exceeding 15 short tons, because of the high center of gravity and the LACV-15 was restricted to operating in calm seas. An inland crane and the crane-on-beach were used to discharge the amphibians. The results of these runs are shown in Table D.6. For 1 nmi off-shore a minimum time of 18.4 hr was calculated for discharging 300 containers with a lighter mix of one LACV-30, three LARC-LXs and seven LARC-XVs.

TABLE D.6

TIME TO DISCHARGE 300 CONTAINERS IN THE BARE BEACH OPERATION USING ALL AMPHIBIANS

Lighters			Distance of Ship Off-Shore (nmi)	Time to Discharge 300 Containers (hr)
LACV-30	LARC-LX	LARC-XV		
1	3	0	1	25.9
1	3	2	1	20.6
1	3	4	1	19.1
1	3	6	1	18.5
1	3	7	1	18.4
1	3	8	1	18.4
1	3	0	3.3	43.9
1	3	2	3.3	37.6
1	3	4	3.3	33.4
1	3	6	3.3	29.5
1	3	8	3.3	27.6
1	3	10	3.3	25.3
1	3	12	3.3	23.2
1	3	14	3.3	22.6
1	3	16	3.3	20.9
1	3	18	3.3	19.9

Another series of runs was made to estimate the effect of increasing the ship-to-shore distance to 3.3 nmi. A time of 19.9 hr was computed for a lighter mix of one LACV-30, three LARC-LXs and eighteen LARC-XVs. Increasing the distance from 1 nmi to 3.3 nmi almost tripled the number of LARC-XVs required.

In summary, during periods of high tide and with the ship 1 nmi off-shore, it would require at least one LACV-30, three LARC-LXs, and six LCM8s to support the operation. Moving the ship to 3.3 nmi off-shore requires one LACV-30, three LARC-LXs, and twelve LCM8s. During periods of low tide with the ship 1 nmi off-shore it requires one LACV-30, three LARC-LXs, and seven LARC-XVs. With the ship 3.3 nmi off-shore one LACV-30, three LARC-LXs, and eighteen LARC-XVs would be required. The above estimates do not include lighters required in the event of breakdowns or for a maintenance float.

IMPROVED BEACH FOR AMPHIBIOUS FORCES

In the improved beach for amphibious forces phase of the main test the elevated causeway and the light-weight amphibious container handler (LACH) were modeled as system elements to off-load containers from lighters at the beach. As before, two cranes were modeled for off-loading the containership with a planned goal of 300 containers per day. One causeway ferry and two LCM8s were held fixed and the number of LCUs was varied in order to achieve a minimum throughput time.

As seen in Table D.7 in the first run the ship was 1 nmi off-shore and the lighter mix consisted of one causeway ferry and two LCM8s and one LCU. In subsequent runs the number of LCUs was increased. A minimum time of 18.7 hr was computed to discharge the ship when the number of LCUs was increased to seven.

TABLE D.7

TIME TO DISCHARGE 300 CONTAINERS IN IMPROVED BEACH FOR AMPHIBIOUS FORCES PHASE OF THE MAIN TEST

Lighters			Distance of Ship Off-Shore (nmi)	Lighter Speed	Time to Discharge 300 Containers (hr)
Causeway Ferry*	LCM8	LCU			
1	2	1	1	Nominal	27.7
1	2	3	1	Nominal	22.1
1	2	5	1	Nominal	19.8
1	2	7	1	Nominal	18.7
1	2	8	1	Nominal	18.7
1	2	5	3.3	Nominal	24.4
1	2	7	3.3	Nominal	21.5
1	2	9	3.3	Nominal	20.1
1	2	11	3.3	Nominal	19.6
1	2	12	3.3	Nominal	19.6
1	2	5	1	Reduced	20.4
1	2	9	3.3	Reduced	20.8

* Four causeway sections.

Next, the ship-to-shore distance was increased to 3.3 nmi. In this case when the number of LCUs was increased to 11 a minimum time of 19.6 hr was achieved. As in the bare beach operation, increasing the distance required a significant increase in the number of lighters but resulted in only a slight increase in total elapsed time.

The last two runs shown in Table D.7 were repeated using reduced speeds for two lighters, to calculate how many extra lighters would be needed. The speeds of both the LCM8 and LCU were reduced (approximately 2 knots) and the speed of the causeway ferry remained the same. When the ship was located 1 nmi off-shore, the minimum time increased from 18.7 hr to 20.4 hr. At 3.3 nmi, the minimum time increased from 19.6 hr to 20.8 hr. These results indicate that total time to Off-load 300 containers is insensitive to the above reduced lighter speeds.

In summary, for the case of the containership located 1 nmi off-shore, it would require at least one causeway ferry (4 sections), two LCM8s and seven LCUs to discharge 300 containers a day. (Extra lighters should be available for breakdowns and maintenance requirements.) For 3.3 nmi at least one causeway ferry, two LCM8s and eleven LCUs are required.

IMPROVED BEACH FOR TERMINAL OPERATIONS

In the improved beach for terminal operations phase of the main test the DeLong pier was modeled as the primary system element to off-load containers from lighters. An inland crane was also modeled for discharging the LACV-30. As before, two cranes were modeled for off-loading the containership with a planned goal of 300 containers a day. The number of LCM8s and LCUs were increased until a minimum throughput time was achieved.

For the first run the ship was 1 nmi off-shore and the lighter mix consisted of one LACV-30, three LCM8s, and three LCUs. In subsequent runs the number of LCM8s and LCUs was increased. A minimum of 17.9 hr was computed to discharge the ship when the lighter mix was increased to one LACV-30, four LCM8s, and four LCUs.

An additional set of runs was then made with the ship 3.3 nmi off-shore. Again, the number of lighters was increased until the minimum time to discharge the ship was determined. One LACV-30, six LCM8s, and six LCUs produced a minimum time of 18.9 hr. Results of the two sets of runs are shown in Table D.8.

TABLE D.8

TIME TO DISCHARGE 300 CONTAINERS IN THE IMPROVED BEACH FOR TERMINAL OPERATIONS PHASE OF THE MAIN TEST

Lighters			Distance of Ship Off-Shore (nmi)	Time to Discharge 300 Containers (hr)
LACV-30	LCM8	LCU		
1	3	3	1	18.3
1	4	4	1	17.9
1	5	5	1	17.9
1	5	5	3.3	19.4
1	6	6	3.3	18.9
1	7	7	3.3	18.9

In summary, for the case of the containership located 1 nmi off-shore, it would require at least one LACV-30, four LCM8s, and four LCUs to discharge 300 containers a day. For 3.3 nmi an additional two LCM8s and two LCUs are required. Extra lighters should be available for breakdowns and maintenance requirements.

TRUCK REQUIREMENTS

An additional set of runs was made to determine the minimum number of trucks required to transport 300 containers from the beach to a marshalling area located 1.5 miles inland. Truck speed and the number of containers carried on the trailer were varied and the results are shown in Table D.9. In the "best" case at least six trucks and trailers were needed operating at the higher indicated speeds and capacities. Additional vehicles will be required for a reserve operational maintenance float.

TABLE D.9

NUMBER OF TRUCKS AND TRAILERS REQUIRED
(Marshalling Area 15 Miles Inland)

Truck Speed (mph)		Number of Containers Per Trailer	Trucks and Trailers Required
Empty	Loaded		
10	10	1	10
10	10	2	8
20	15	2	6

APPENDIX E

SHIPBOARD CRANE OPERATIONS

The normal loading and unloading procedures in improved terminal facilities cannot be duplicated during a LOTS operation. Modern dock-side cranes can rapidly move containers to and from the ship. Crane cycle times for loading or unloading either one 40-ft or two 20-ft containers are often less than 2 minutes. Several cranes can and often are used simultaneously to reduce port turn-around times.

As can be seen in Figure E.1, the containership chartered for the main test, a C5-S-73b (C573) hull type, has eight bays located between the deck houses and one more at the stern of the ship. Each bay has two hatch covers, the starboard one being the larger of the two. Two bays constitute a hold, which is separated from other holds by watertight bulkheads. (Hold No. 5, which has only one bay and one hatch cover, is the exception.) Bays No. 2 through No. 8 have seven 40-ft container cells below deck and space for twenty-seven 40-ft containers above deck. The other bays are smaller. Containers can also be stacked up to six levels (tiers) below most hatch covers and three tiers above them. Two 20-ft containers can be fitted into one 40-ft cell.

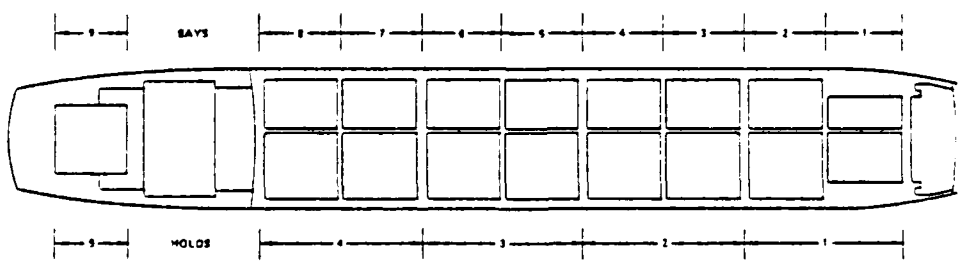


FIGURE E.1. CARGO STOWAGE SPACES FOR A C573 NON-SELF-SUSTAINING CONTAINERSHIP

When in a modern terminal facility, dockside cranes usually load or off-load all of one tier before moving to the next lower tier. This minimizes the potential list which would result if cells were loaded or unloaded sequentially. Actual load imbalances are seldom aggravated during loading and discharging because the rapid crane cycling quickly neutralizes the differences.

In an off-shore environment container operations will be more sensitive to the stability of the ship. In the case of the LOTS main test the crane-on-deck (COD), a Manitowoc 4100W model 200-ton capacity crane, will operate from the centerline of the ship. It can move all containers in the bays immediately fore and aft of the crane's position. With such a capability tiers could be discharged and unloaded sequentially in a manner similar to dockside cranes. Thus, ship stability should not be a problem. Two COD's as envisioned in actual LOTS operations should also have no adverse effect on ship stability.

Ship stability does become a matter of concern, however, when only one temporary containership discharge facility (TCDF) is used during loading and off-loading. With a 100-ft boom, the TCDF can only reach to the centerline of the ship. When one TCDF is operating alone, it can only off-load (or load) that amount of weight which can be accommodated by shifting ballast. Then the TCDF must move to the opposite side of the ship and the ballast must be shifted back as off-loading (or loading) continues. In discussions with officials from American Export Lines, owners of the test ship chartered, when one TCDF is working the ship, only one side of a bay could be worked before switching sides. In extreme cases where containers are loaded to their maximum allowable weight, it may be necessary to switch sides more than once to completely load or unload one bay. Normally tolerances of 3-4 degrees of list are allowable.

During the main test, the COD will be employed and can partially offset the effects of TCDF operations. With such an arrangement each crane can simultaneously load or off-load two bays. Each crane, however, must operate on opposite sides of the ship. The following is one way this could be accomplished (assume first an off-loading situation):

- The COD, located on the centerline of bay No. 7, unloads all the containers above and in the cells below the port hatch covers of bays No. 6 and No. 8. Meanwhile, the TCDF unloads all containers above and in the cells below the starboard hatch covers of of bays No. 4 and No. 3. (See Figure E.2.)

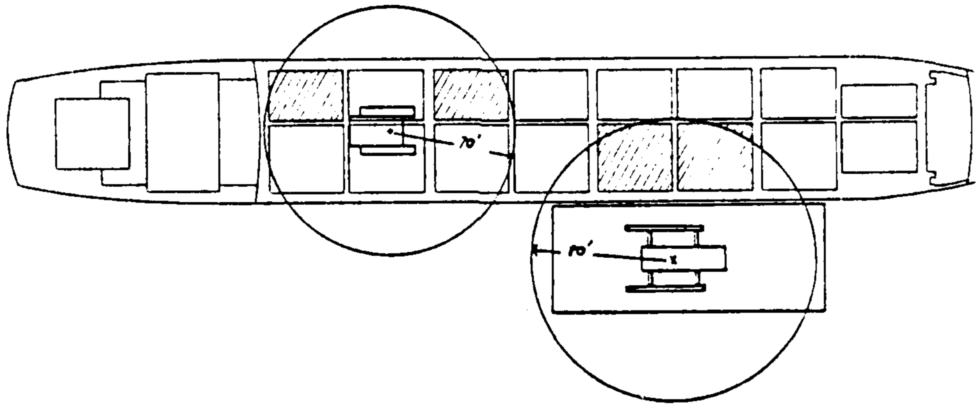


FIGURE E.2. COD AND TCDF POSITIONED TO BEGIN DISCHARGE

– The TCDF then switches to the port side of the ship and unloads the remaining containers in bays No. 4 and No. 3. Concurrently, the COD completes the unloading of bays No. 8 and No. 6 (See Figure E.3.)

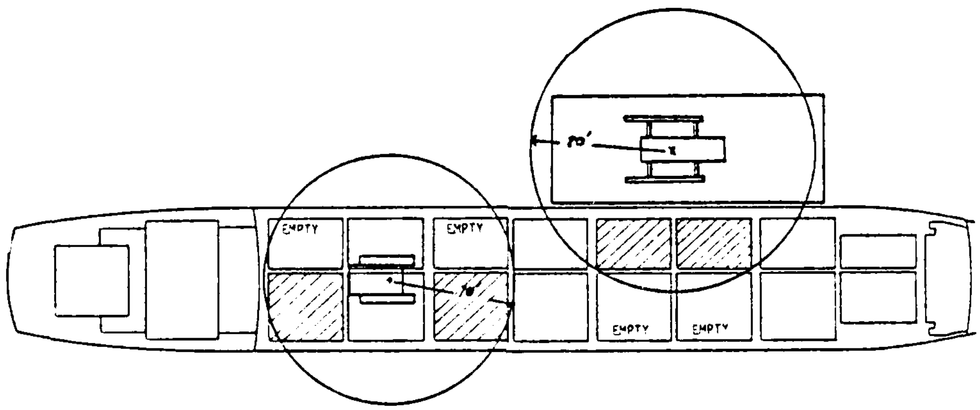


FIGURE E.3. POSITION 2
(With the TCDF repositioned, both cranes off-load from opposite sides of the ship.)

– The COD then repositions to bay No. 6 and commences the off-load of all containers above and in the cells below the starboard hatch covers of bays No. 7 and No. 5. Meanwhile the TCDF unloads all containers above and in the cells below the port hatch covers of bays No. 2 and No. 1. (See Figure E.4.)

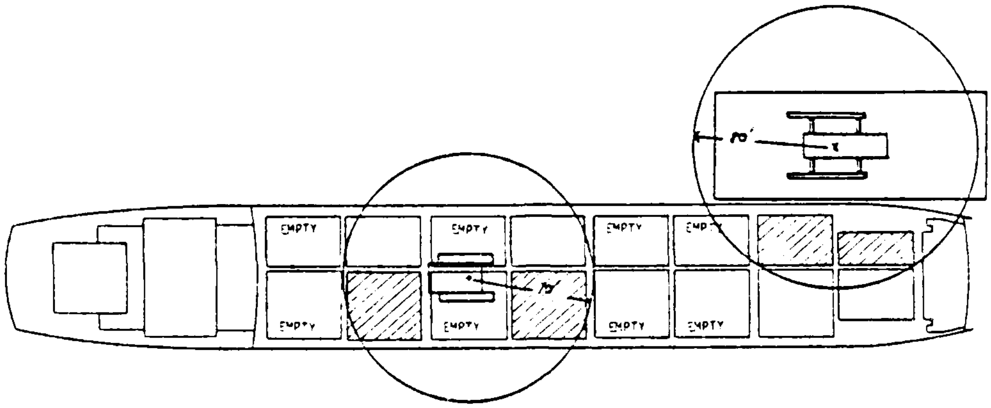


FIGURE E.4. POSITION 3
(Both cranes advance toward the bow.)

– The TCDF then switches to the starboard side of the ship and unloads the remaining containers in bays No. 2 and No. 1. Concurrently, the COD completes the unloading of bays No. 7 and No. 5. (See Figure E.5.)

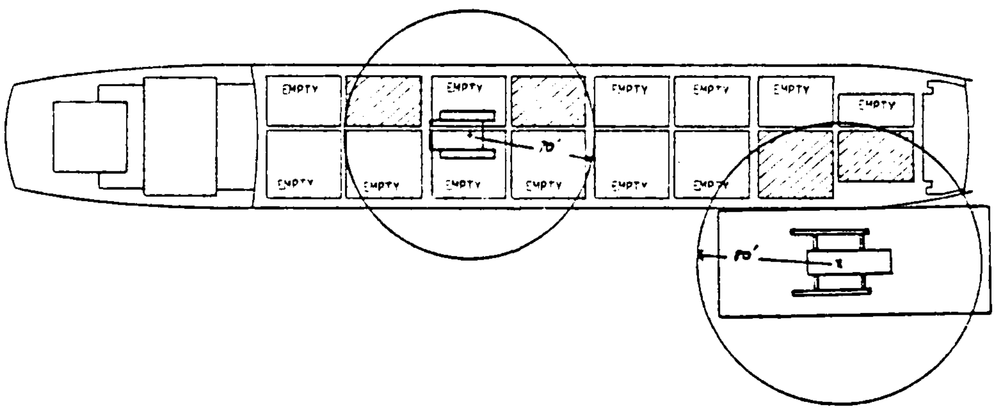


FIGURE E.5. POSITION 4
(The TCDF is repositioned to the starboard side and both cranes unload opposite sides.)

The above scenario will offer some weight imbalances, however, these are well within the ship's neutralizing capabilities of switching ballast. To satisfy a retrograde after an off-load, the following scenario is offered:

The TCDF commences to load containers above and in the cells below the starboard hatch covers of bays No. 7 and No. 8. Meanwhile, the COD which has been repositioned to bay No. 3, loads containers above and in the cells below the port hatch covers of bays No. 2 and No. 4. (See Figure E.6.)

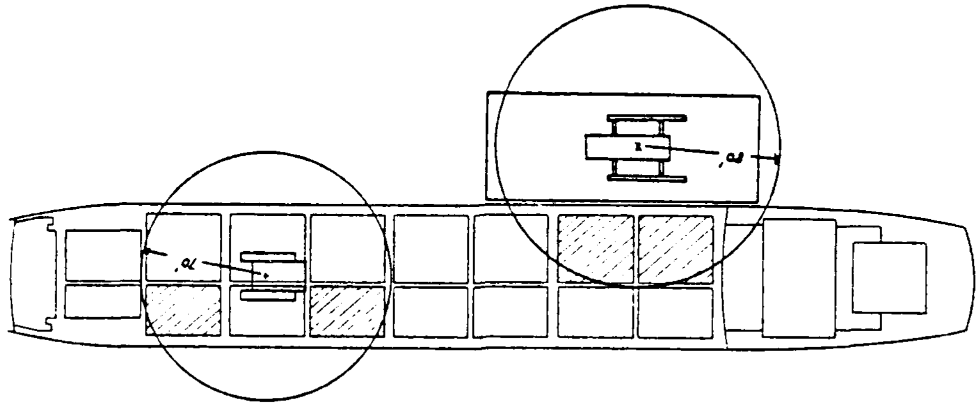


FIGURE E.6. NEW POSITIONS FOR RETROGRADE (POSITION 5)
(Both cranes load containers at opposite sides of the ship)

The TCDF then switches to the port side of the ship and completes the loading of bays No. 7 and No. 8. Concurrently the COD completes the loading of bays No. 2 and No. 4. (See Figure E.7.)

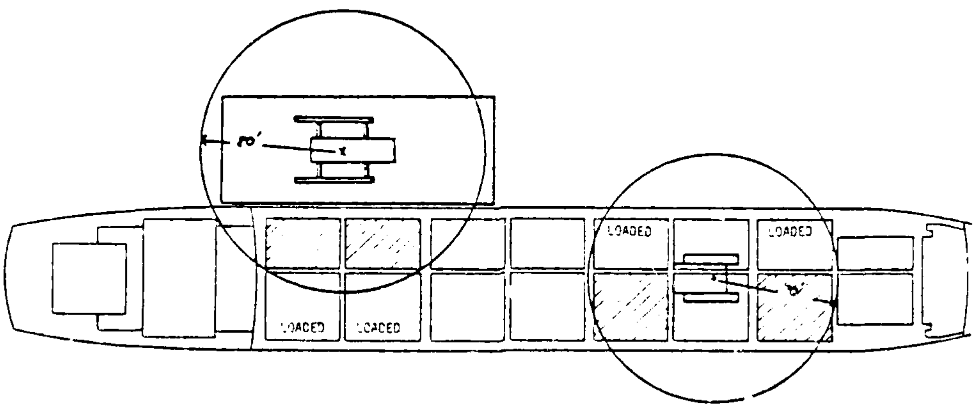


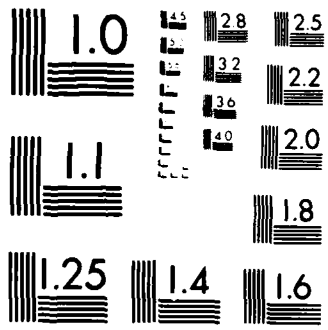
FIGURE E.7. POSITION 6
(To maintain trim the TCDF is shifted to port side and the cranes load opposite sides.)

The COD is then repositioned to bay No. 2 and loads containers above and in the cells below the starboard hatch covers of bays No. 3 and No. 1. Meanwhile, the TCDF loads containers above and in the cells below the port hatch covers of bays No. 5 and No. 6. (See Figure E.8.)

AD-A149 371 MAIN TEST DESIGN OF THE JOINT LOGISTICS-OVER-THE-SHORE (LOTS) TEST AND EV..(U) ORI INC ROCKVILLE MD H CASEY ET AL. 20 JUN 77 ORI-TR-1132A MDA903-75-C-0016 2/2

UNCLASSIFIED F/G 15/5 NL

END
FILMED
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

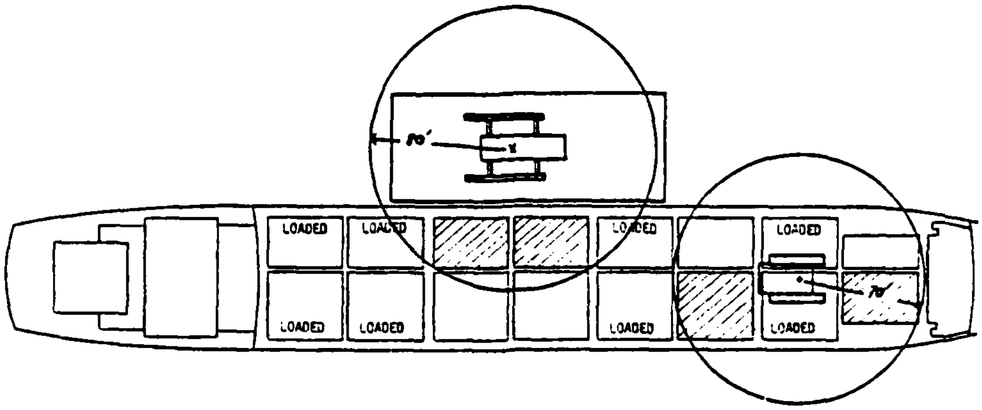


FIGURE E.8. POSITION 7
(Both cranes are moved toward the bow to continue loading.)

The TCDF switches back to the starboard side of the ship and completes the loading of bays No. 5 and No. 6. Concurrently the COD completes the loading of bays No. 3 and No. 1. (See Figure E.9.)

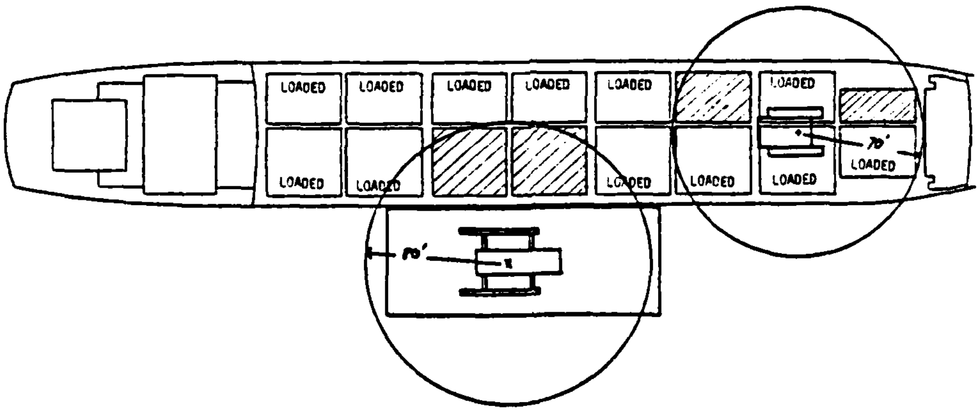


FIGURE E.9. POSITION 8
(The TCDF is repositioned to the starboard side and both cranes load remaining containers.)

The above scenarios provide for the minimum shifting of the TCDF and permit each crane to service all the hatches between the deck houses. Normally, bay No. 9 will not be used because of the potential problems that could result from the barge riding against the rudder post.

When both cranes have finished loading or unloading a particular set of bays and one crane is being repositioned, the other crane should not

commence operations until the repositioned crane is also ready to continue. This will eliminate unnecessary ballast shifting. An exception to this could be loading or unloading of cell No. 1, located directly over the centerline by the crane not repositioning and with the capability of recovering the bay hatch cover.

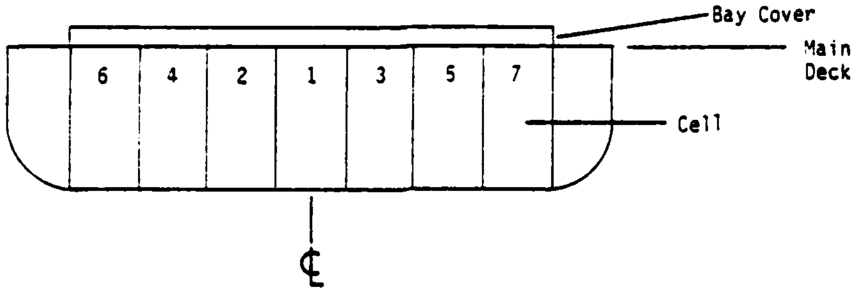


FIGURE E.10. CELL PROFILE FOR A C573 CONTAINERSHIP
(NOTE: Cell No. 1 is located directly over the centerline. Odd numbered cells are starboard, even numbers on the port side.)

As noted in Table E.1, the TCDF cannot lift a fully loaded 40-ft seavan (approximately 68,000 lb) with the boom operating at an 80-ft radius. The distance between the crane's rotation centerline and the ship's centerline (with a 5-ft fender) is approximately 74 ft. With no derating, such a lift is possible. With a seastate one condition, the lift is questionable. Increasing seastates further degrade the probabilities. Based upon this information and considering the dynamic operational environment, it would be prudent not to place any 40-ft containers in or on deck above cells 1, 2, and 3.

TABLE E.1

DERATING OF 6250 CRANE FOR THREE SEA STATES
(Figures shown include weights of hooks and spreaders. To find maximum weight for lifting container, subtract 9,800 lb when using hydraulic spreader, or 6,000 lb when using manual spreader.)

Crane Radius (Ft)	Maximum Load With No Derating (100-ft boom*)	Derated Maximum Loads		
		Seastate 0-1	Seastate 2	Seastate 3
30	264,000			
35	211,500			
40	172,000			
45	144,000			
50	124,000	80,000 lb	58,000 lb	48,000 lb
60	96,200			
70	78,000	75,600 lb		
80	65,200	62,800		

*Source: load plate data for class 18-1682, from Harnishfeger pamphlet TX 538C-1.

END

FILMED

2-85

DTIC